THE MARINE REVIEW

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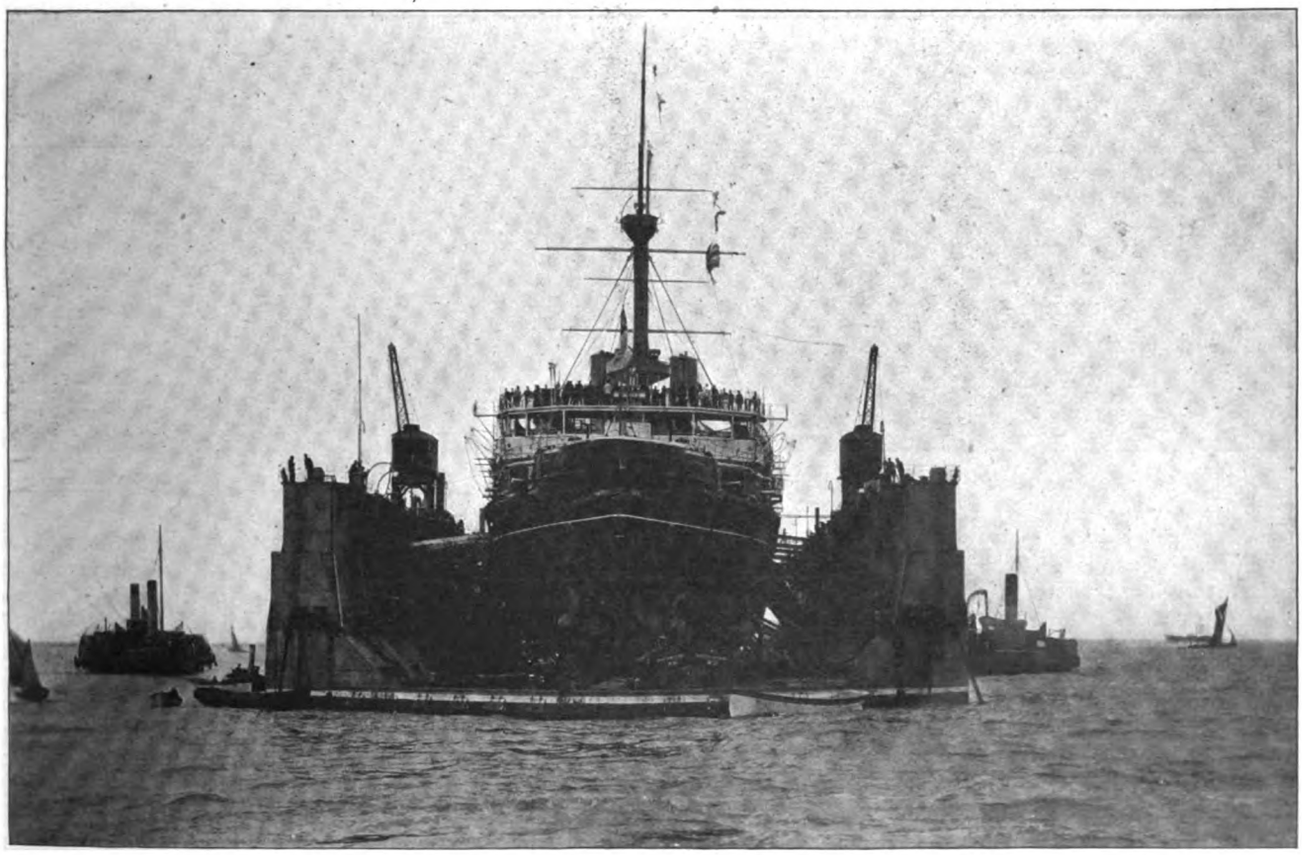
FLOATING DOCKS.

Mr. William Denton, a well known ship builder on the Tyne in Britain, has compiled some interesting particulars relating to floating docks, and he has furnished us with a number of photographs illustrating the various types and sizes of docks which have in recent years been built by the well known ship building firm of Messrs. Swan, Hunter & Wigham Richardson, Ltd., with which Mr. Denton is associated. He says that during the past ten years the floating dock has come into more general use, owing to its advantages having become more widely known, and during that period there has been a demand for them from all quarters of the globe. Docks have been built in Britain for the British, Japanese, Spanish and Natal governments, also for Germany, Suez canal, Port Mahon, Russia, West Africa, and for many ports in the United Kingdom. According to the British Admiralty Dock Book and Lloyds Register the number of floating docks now in use in all parts of the world appears to be not less than 210, some of which have been in use over 40 years, notably the Alexandria and Callao docks. The first dock at Bermuda has been in use 37 years. But none of these docks is constructed on the self-docking principle. Mr. Lionel E. Clark, M. I. C. E., in a paper read before the Institution of Civil Engineers, London, last year, outlined the many advantages of floating docks as a method of getting at the under water portion of ships, and it may be of interest to briefly note what he then said on this appliance for docking ships. He pointed out that



BERMUDA DOCK WITH H. M. S. SANSPAREIL LIFTED. CAPABLE OF LIFTING VESSELS UP TO 16,000 TONS CAPACITY. BUILT BY SWAN, HUNTER & WIGHAM RICHARDSON, WALLSEND, FOR THE BRITISH GOVERNMENT.

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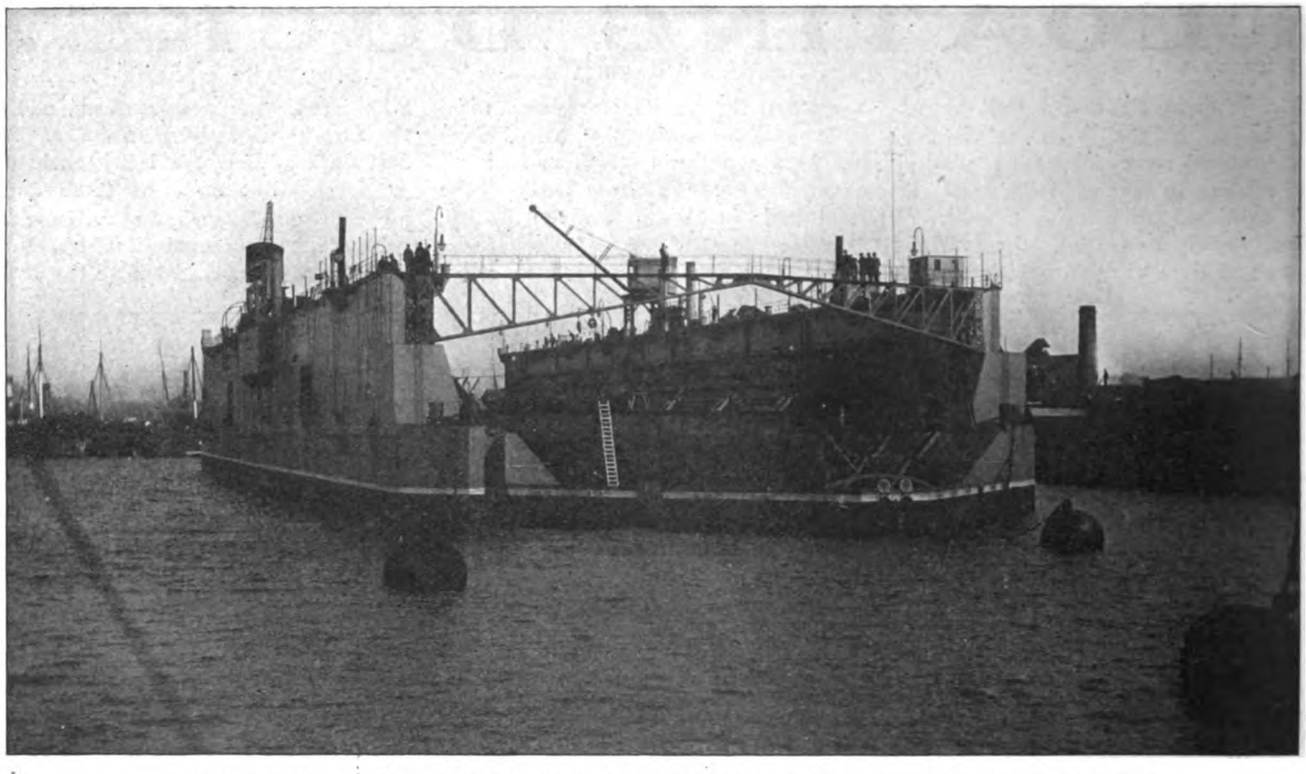
the time required for constructing a floating dock was much less than that needed for the excavated dock, and gave instances of large docks having been completely designed and built in well under a year. In the building of excavated graving docks there are situations where they could not be constructed, except at enormous outlay and expenditure of time, but in the case of a floating dock there is no river, harbor or dock in which a dock of this description could not be stationed, provided the depth of water is sufficient to allow it to be sunk, and failing this desideratum dredging could always be resorted to. The "off shore" arsenals, which are naturally always placed at some distance from the sea, for it could be sent down the channel to pick up and pack "lame ducks" before they attempted the narrow passage leading to the arsenal. He also mentions that it has been even proposed that a floating dock should accompany a fleet into action, ready to pick up wounded vessels after an engagement, but in his opinion this is not yet a practical scheme, the difficulties of propelling such a dock even at ordinary cruising-speeds being insurmountable. At the same time he strongly advocates the use by all naval powers of a floating dock towed by a vessel containing ordinary ship-repairing tools, which could at any time be easily transferred to any base that the fleet may have seized, or could provide or supplement the docking accommodation in those home ports where the same did not exist or was of insufficient capacity. The drawback to the extensive use of such a dock would naturally be the depth of water required at its moorings, but it is pointed out that the maximum amount of excavation required for the berth of a floating dock would never be more than that required for the excavated dock, with the advantage that, whereas in the latter case, the excavation would have to be made entirely in the dry, in the former it would merely be the removal of material by ordinary dredges. On the other hand, the floating dock possesses many advantages in the choice of site, since it can be placed end or with the stream, thus facilitating the entrance of vessels; and it does not require its entrance to be placed, like that of most graving docks, more or less at right angles to the stream. Again, in rivers which are subject to a strong freshet, the floating dock is equally available either at high or low water, whereas a stone graving dock would either have to be built very much deeper than required, or else would be submerged in times of flood. Mr. Clark also discusses the point whether a vessel on a floating dock is not much better placed for purposes of repairing or painting than in the bottom of an excavated dock, and points out how open to light and air are vessels on the former. He also claims that this openness of the floating dock has other advantages in that it allows them to deal with vessels of much greater length than the dock itself. For example, a dock 350 ft. long over the keel blocks could with perfect safety lift a vessel 400 ft. in length, or even longer, provided its weight did not exceed the lifting capacity of the dock. One-sided docks have likewise an equal advantage as regards beam of vessels lifted. It is admitted that floating docks have their limitations, represented by the amount of their lifting power, but at the same time it is argued that though they may not be able to lift a vessel entirely,



BERMUDA DOCK OF 16,000 TONS LIFTING CAPACITY. VIEW SHOWING CENTER PONTOON SELF-DOCKED.

type or one sided dock is also a very accommodating appliance where land for a graving dock is not obtainable, and our illustrations show one of this kind at Sunderland, while their practicability has also been demonstrated at the important shipping centres of the Tyne, Wear, Cardiff, etc., in Britain. Floating docks have also the advantage of mobility in that they can be built in the cheapest and most suitable yard, and then towed to their destinations, while in case of certain changes taking place in the port where it is located, it can be bodily moved to any more suitable place, or to where it can be more advantageously utilized. From a strategical point of view, the advantage of mobility, Mr. Clark points out how such a dock would be useful in connection with any existing

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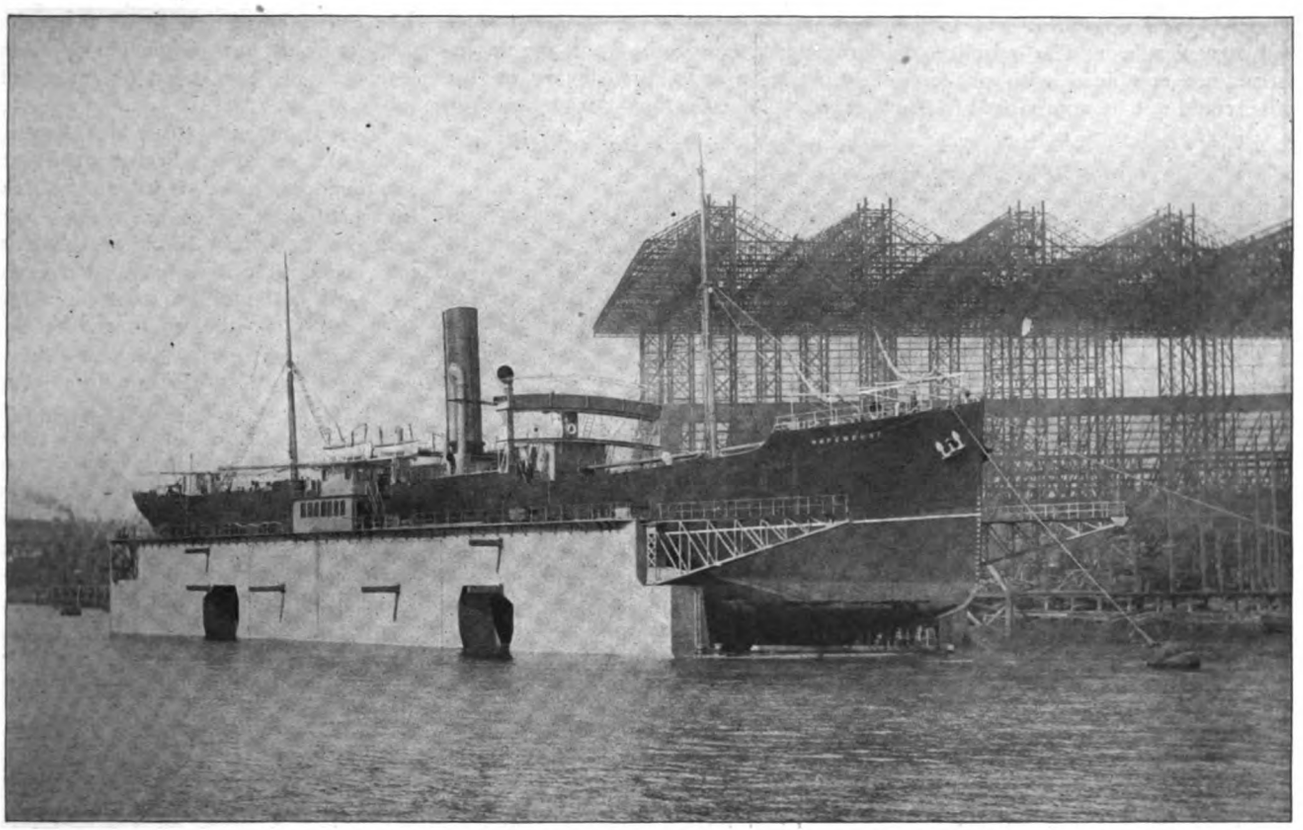
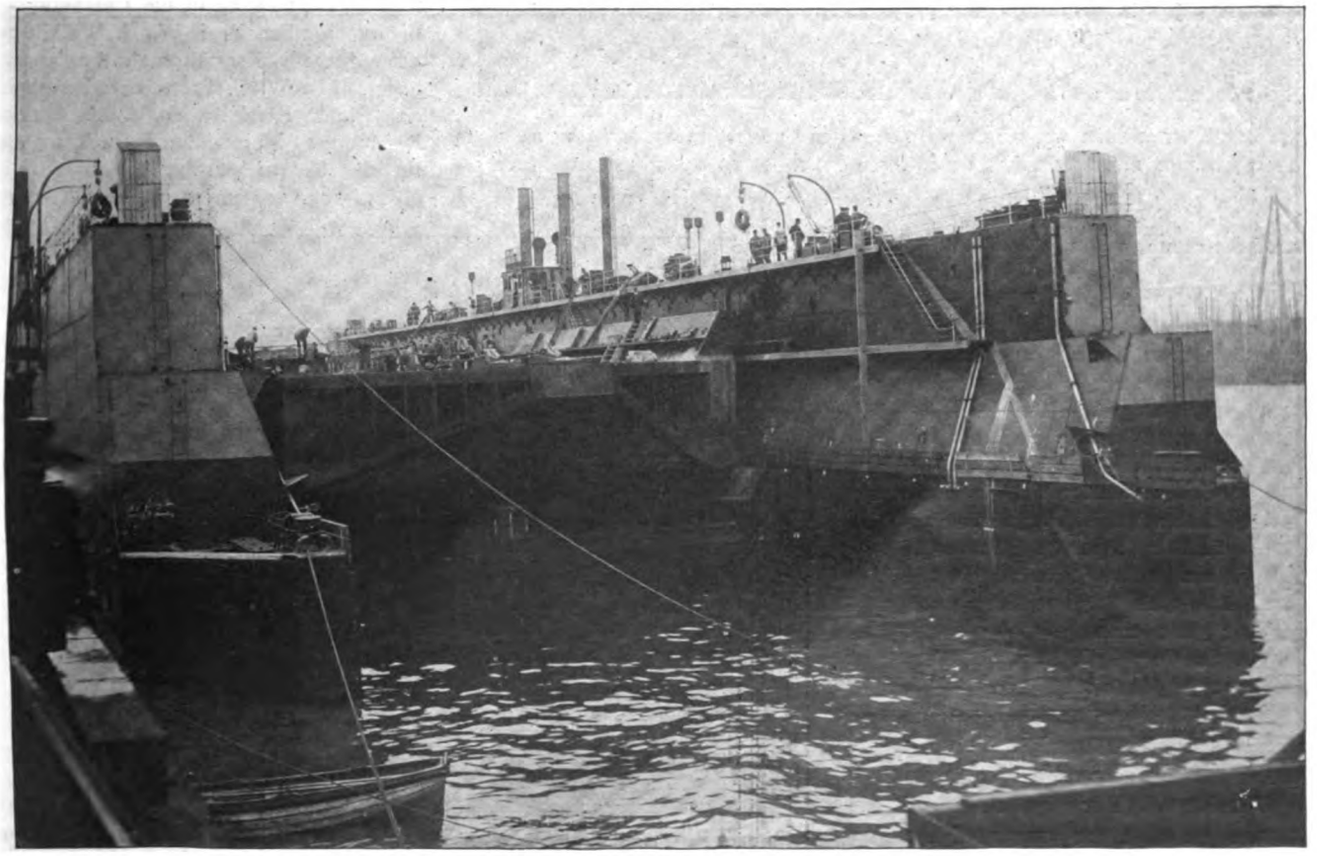


PORT SAID FLOATING DOCK OF 3,000 TONS CAPACITY. VIEW SHOWING STEAMSHIP HOPE MOUNT LIFTED DURING TRIALS AT BUILDERS' WORKS. BUILT FOR THE SUEZ CANAL CO. BY SWAN, HUNTER & WIGHAM RICHARDSON, WALLSEND-ON-TYNE.

they can frequently lift it enough to enable the required repairs to be effected. As to first cost, Mr. Denton asserts that it would not be difficult to prove that, except under extraordinarily favorable conditions, the floating dock is by far the cheaper of the two to construct. In any case the latter is not problematical, it can be fixed



DURBAN FLOATING DOCK OF 8,500 TONS CAPACITY. VIEW SHOWS END PONTOONS LIF TED ON CENTER PONTOON, I. E., END PONTOONS SELF-DOCKED.

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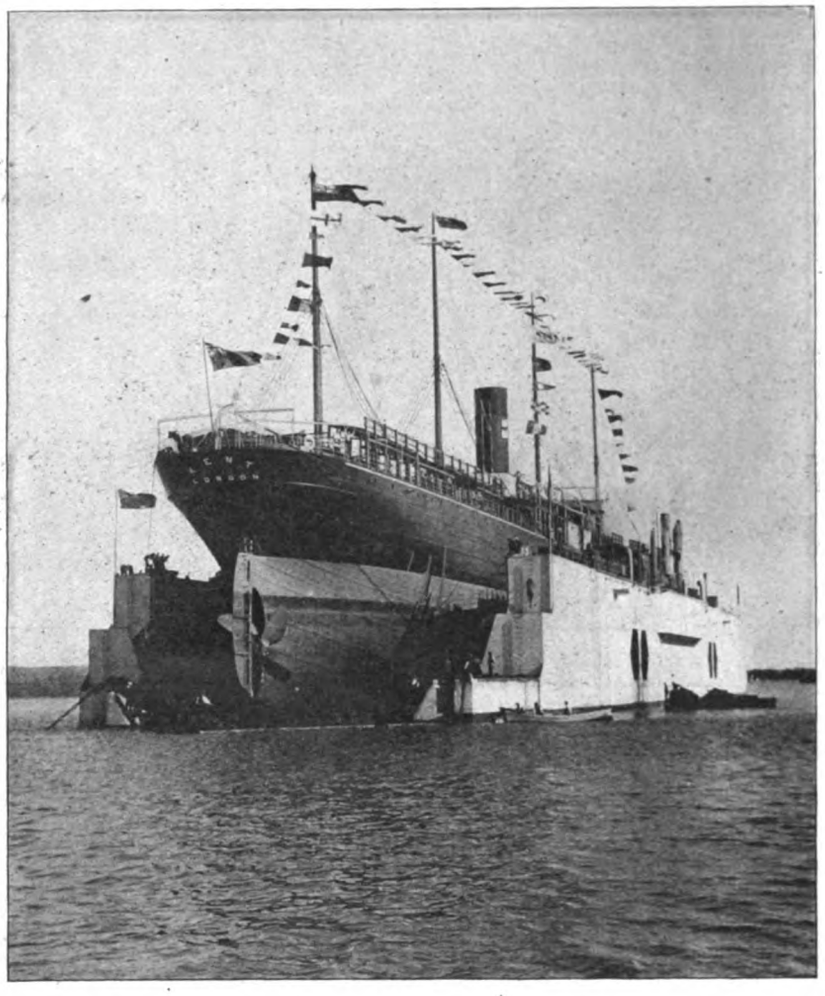
accurately, even though it had to be towed 10,000 miles. The rapidity of construction, combined with accuracy of cost, could not be approached in the case of the stone graving dock. As regards durability and cost of upkeep, ample data is now available on which to found the deliberate pronouncement that with reasonable care and attention the life of a floating dock may be indefinitely prolonged. The floating dock has a great advantage in respect of the cost of coal and oil, as the power required to lift a ship is much less than that required for a graving-dock of similar capacity. Instances can be given where it costs, on the average, less than $4.50 to lift vessels displacing 3,000 tons. As the useful life of a floating dock may be fairly taken as at 50 years, it requires only a sinking fund equal to one per cent per annum on the first cost of the dock invested at 2½ per cent. The average cost of maintenance is very little more than one per cent per annum of the first cost of the dock. In thus outlining the advantages of the floating dock, there is no intention to disparage in any way the time honored stone graving dock. Both types are of inestimable use to the navies of the world. The floating dock, however, has come to stay, and it supplies a long felt want in innumerable ports where the construction of a graving dock is either not practicable or where it could only be carried out at a prohibitive cost.

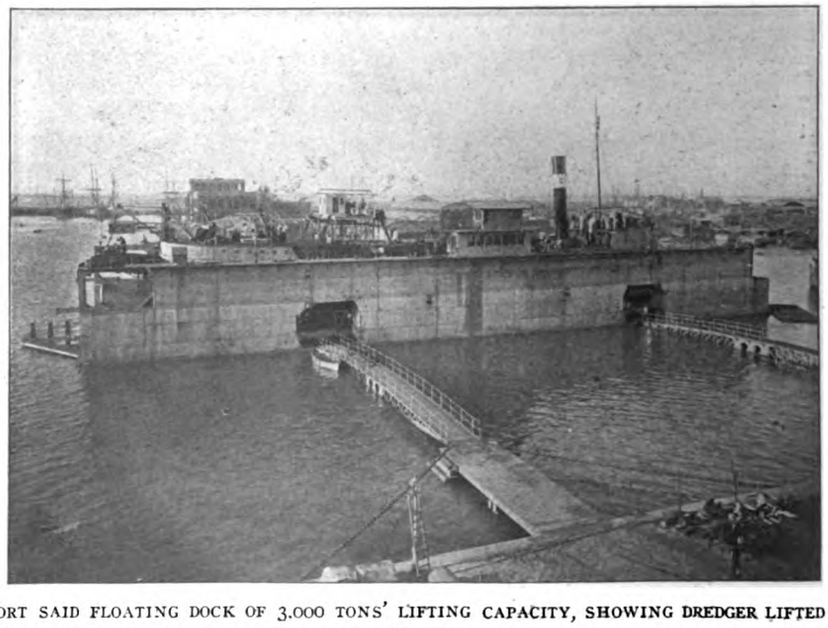


DURBAN FLOATING DOCK WITH THE MAIL STEAMER KENT LIFTED. THIS DOCK IS CAPABLE OF LIFTING VESSELS UP TO 8,500 TONS. BUILT BY SWAN, HUNTER & WIGHAM RICHARDSON FOR THE NATAL GOVERNMENT.

The various uses to which floating docks can be put has been brought into prominence by the wreck of the British battleship Montagu, now being salved near Lundy Island in the Bristol channel. The draught of water in the damaged hull will be so great whenever she is floated, as to render it a matter of impossibility to place her in any available dry dock without first beaching her, and executing some repairs. That being so it is proposed to tow the floating dock now at Bermuda, which is sufficiently large for the purpose in view, to Lundy, and place the ship in it for temporary repairs. If the Montagu is ever got off the rocks, the risk of sinking during the process of salvage, will be avoided by slipping underneath her the floating dock which will lift her sufficiently until bottom can be repaired.

COLD STORAGE AND ICE ASSOCIATION.

Liverpool is the especial port for the importation of frozen meat and fruits of all descriptions, and it is also the head center in Britain of cold storage. So much is this that the port has a Cold Storage and Ice Association, which has a large number of members. Last month they held a meeting in the University of Liverpool, when Prof. W. H. Watkinson showed the visitors through the laboratories. Mr. W. G. Brettell read a paper on "Ship's Refrigeration, With Special Reference to Maintaining Even Temperatures." This important paper is fully given in our contemporary, *Cold Storage*, from which we give some extracts.



PORT SAID FLOATING DOCK OF 3,000 TONS' LIFTING CAPACITY, SHOWING DREDGER LIFTED AT PORT SAID.

Mr. Brettell said that ship refrigera-

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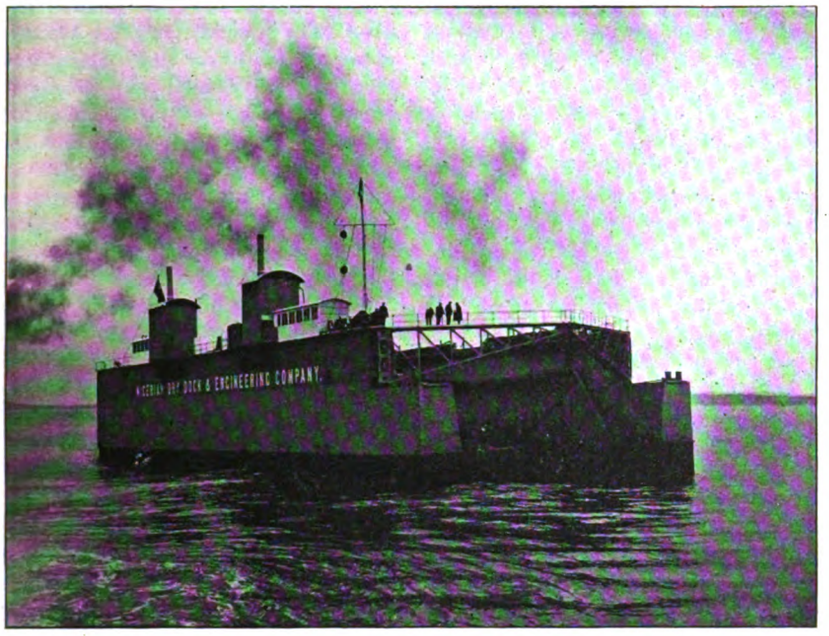
tion was one of the earliest branches to claim the attention of the engineer, and, it is now some twenty-seven years since Coleman with his cold-air machine fitted on board the S. S. Stratheven brought from Australia to this country some 34 tons weight of solidly frozen mutton and beef.



NIGERIAN FLOATING DOCK OF 2,700 TONS CAPACITY. VIEW OF DOCK AT SEA PRIOR TO COMMENCEMENT OF VOYAGE TO FORCADOS, WEST AFRICA. BUILT FOR ELDER, DEMPSTER & CO. BY SWAN, HUNTER & WIGHAM RICHARDSON, WALLSEND.

The business rapidly developed, and a large number of cold-air machines were fitted and successfully worked in the succeeding years. This type has been generally superseded, though even at the present day it is in use for the carriage of frozen cargoes, mainly mutton, and for the preservation of ships' provisions.

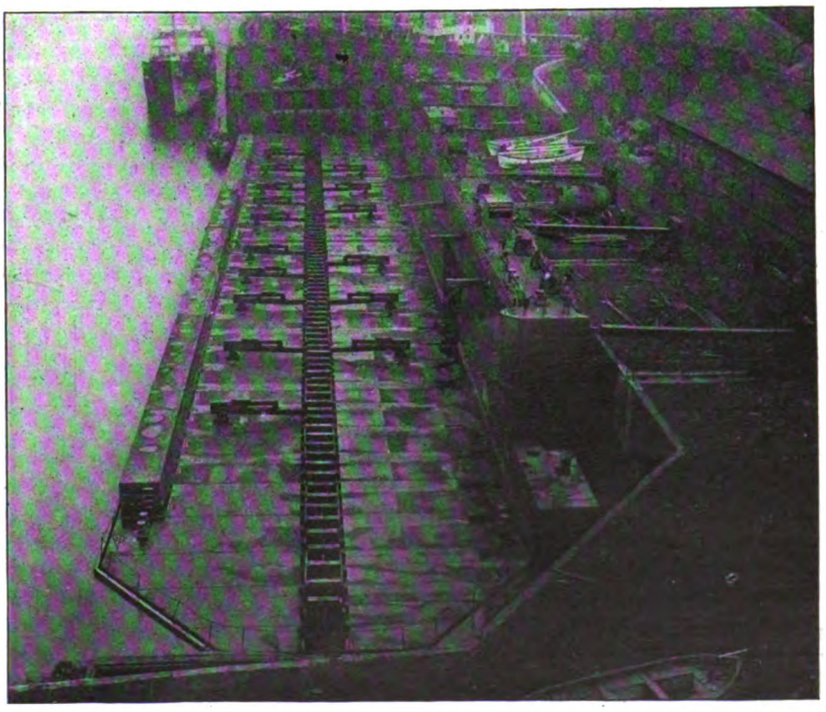
In the year 1887 an American engineer, Mr. J. K. Kilbourn, introduced the ammonia-compression machine, the first installation being fitted on board the Inman & International steamer City of Berlin, followed by a large number of North Atlantic steamers of the Inman, Cunard, Leyland, and other lines. These were all fitted for the carriage of chilled beef from America to this country, a duty for which the cold-air machines were not well suited.

About the same time the Linde Co. commenced to fit similar type machines, and shortly afterward Messrs. J. & E. Hall introduced their patent carbonic anhydride machine. By far the larger number of present day ship installations are either of the ammonia-compression or carbonic-anhydride type.

It is a matter of some remark that, enormous as is the chilled meat trade, comparatively small attention has been given to it by makers of refrigerating machinery. The American meat exporters have long recognized the extreme care which must be observed both in handling and transport, and it is considerably to their credit that they are able successfully to send us about one half of our total beef supply, the animals being mostly killed in the abattoirs of Chicago and Kansas City, and sent across the American continent by rail in iced cars to New York, Boston, etc., thence to be shipped to Liverpool and London. Until a few years ago it was thought impossible to carry chilled beef across the tropics. Many attempts had been made, but these, owing to a want of appreciation of the conditions necessary for success, proved failures.

In 1899 the River Platte Fresh Meat Co. fitted a small installation of ammonia-compression machinery with brine piping on board the S. S. Zulieka, the insulated chamber being specially railed and fitted for chilled beef. The work was carried out and arranged by the Liverpool Refrigeration Co. The experiment was entirely successful, the meat arriving from South America in perfect condition several voyages in succession. Since then a large number of vessels have been fitted, with the result that the North American monopoly is encountering serious opposition from a well-established and vigously-growing trade.

It has been repeatedly stated that it is impossible to carry chilled meat for a longer period than 25 to 30 days, and that consequently we cannot hope to import it in any but a frozen condition from Australia or New Zealand. I should like emphatically to combat such a statement. In the experience of the company with which I am connected our machines fitted on the slower boats trading between South America and this country frequently have chilled meat on board for over 40 days. So far from not being able to import chilled meat from Australia, I think, giving due observance to the conditions essential to success, there is little difficulty in doing so. I should hesitate to say that 100 days forms a limit beyond which chilled



OFF-SHORE FLOATING DOCK AT SUNDERLAND CAPABLE OF LIFTING 3,500 TONS. BUILT FOR MESSRS. S. P. AUSTIN & SON, LTD., BY SWAN, HUNTER & WIGHAM RICHARDSON, WALLSEND-ON-TYNE.

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meat cannot be kept without deterioration.

It is well known that while hard freezing has no deteriorating effect upon mutton or pork, this is not the case with beef. Frozen beef, on account of its inferior appearance when thawed out, commands very much lower prices than if chilled only. It is manifestly better, therefore, to import in the chilled rather than in the frozen condition, and it is probable in the near future, much of the beef now coming frozen will be sent chilled instead, to the advantage of all parties concerned.

The carriage of frozen mutton is a comparatively simple matter.

With chilled beef, however, extreme accuracy of temperature is absolutely essential, and much greater care is required right through from the time the cattle are killed until the beef is delivered to the consumer.

Once loaded on board the temperature if slightly higher should be lowered to 29½ degs. Fahr., and steadily maintained at this point during the whole voyage. This at first may seem a comparatively easy matter, but it is one of considerable difficulty, the slightest fluctuation in temperature having a most marked effect upon the condition of the cargo at the end of the voyage. The meat chambers must be specially arranged, and great care taken in the detail if the best results are to be obtained.

In the case of fruit carriage also, especially the more delicate kinds of fruit, sufficient attention has not hitherto been given to the necessity of accurate temperatures, and far more reliable and better results will be obtained when this fact is more generally appreciated.

I am able to reproduce one or two diagrams taken from self-registering thermometers placed in the insulated chambers of North Atlantic steamers carrying chilled beef between Boston and Liverpool. You will see from these, which are samples selected at random from a large number of records, how very evenly the temperatures have been maintained during the voyage. The indicator pen marks a straight line, and there are no appreciable fluctuations up or down when once the temperature has been reduced to that required.

Turning now our attention to the machinery, the requirements of marine work have produced several well-known types of machines in which the maximum refrigerating power is contained within the minimum space and weight. Both these latter are of great importance on shipboard. Compactness, however, must not be carried, as it is unfortunately in not a few examples, to the extent of making an overhaul a matter of considerable difficulty and expense. Nothing is appreciated by the sea-going engineer more than a machine that is thoroughly "get-at-able" in all its parts.

The storerooms are almost invariably cooled by brine piping arranged in them, either overhead or round the sides and ends, or both, and with a complete system of valves and by-passes, so that the amount of cold brine supplied to each chamber can be regulated exactly as desired, or the cooling surface partially or wholly cut off at will.

Occasionally the air-circulation system is used, the cooling pipes being arranged in a suitable battery, and the air circulated by an electric or other fan and distributed through air ducts in the usual way. Sometimes a combination of both systems is used.

It is a curious fact that the naval architect, in fixing the position of the ship's chambers, very frequently finds for them the hottest portion of the ship, generally as near the main boilers as possible. This is the case in several of the finest installations which have come under my notice.

Mr. Brettell showed on the screen the arrangement of a refrigerating engine room for a large Australian liner. You will notice the machinery is direct steam driven and is in duplicate throughout. This is very essential especially on long voyages; the safety of the cargo worth, perhaps, £50,000 or a great deal more depends absolutely upon the efficient working of the refrigerating plant. Usually one-half the machinery working full is sufficiently powerful to maintain the necessary temperature even in the tropics, so that by having all parts in duplicate and interchangeable, the risk of total disablement is very small indeed.

The crankshafts and steam cylinders are so arranged that the machine can work compound, or two high-pressure engines, each driving its own compressor, or the compound engine may drive either one or both compressors. The gas condensers are of vertical, circular form, but in the smaller sizes they may be arranged in the box bed under the machines.

An independent steam condensing plant is provided, also independent water pumps of the vertical duplex type, these frequently placed down in the main engine room below the water line. The independent steam condenser has many advantages over one attached to the machine.

A special feature of the plant shown was that the evaporators (which are generally similar in construction to the condensers), and the other cold parts are not individually lagged, but are placed together in an insulated room where they are always accessible for examination and overhaul. By this means much more effective protection can be ensured from outside heat. There is no lagging to be taken down and replaced when overhauling, and the ironwork of the various parts can always be kept clean and painted.

It is well to have all portions of the plant fully in sight. A great deal of unnecessary corrosion and rust accumulation goes on behind the clean-painted exterior surfaces of the lagging, which too often covers a wet mass of material which was once an insulator, but is no longer. The brine pumps have extension pieces which pass through the insulation so that the steam cylinders are outside and the pump ends inside the insulated room. The glands and other parts of the pump are perfectly accessible. The small brine tank is simply used for mixing additional brine or for heating the brine for thawing down after the cargo has been taken out. The brine is circulated in an entirely closed system; there are no open return tanks whatever.

As the machinery is frequently situated at a considerable distance from some at least, of the meat holds, one or more distributing houses are arranged in convenient positions immediately over these, and suitable brine mains are carried between the refrigerating machine room and the distributing houses. The holds, which are adjacent to the machine room, are controlled directly from headers within the refrigerator house.

The meat holds are fitted throughout with galvanized wrought-iron brine piping arranged overhead, and on the sides and ends of the holds and 'tween decks and divided into a suitable number of independent sections each with control valves at either end, and all coupled to one or more pairs of headers, which are in turn connected by mains to the brine pumps and evaporators. The brine pumps draw from the evaporators, deliver through the mains into the distributing headers, thence to the various sections of piping in the holds or 'tween decks, returning through similar section control valves to the collecting headers, which are in turn connected to the evaporators. From the top of each evaporator a vent pipe, fitted if required with an automatic trap, is carried through the deck to the open air, the end being turned over and fitted with a gauge cap, any gas which may be generated or collected in the pipe system is automatically disposed of. The whole brine circulation forms an entirely closed system.

Those who have not a practical acquaintance with this method of brine distribution, raise the objection that it is impossible to regulate the various sections equally and as required, since the brine cannot be seen returning from each section as may be done when the returns all

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flow into an open tank. This difficulty, however, exists only in imagination, there is no reality whatever about it. My firm have for many years past fitted scores of installations, including some of the very largest afloat, all on the closed system, both for frozen meat, fruit, and for chilled beef carriage, the latter requiring the most accurate and even adjustment possible. We have never found the slightest difficulty in regulating the brine supply exactly as required by the thermometer. We always fit the closed circuit in preference to the open one. I think the open tank a primitive arrangement and open to several serious objections; a little carelessness or irregularity in the working of the brine pumps, and the tanks may soon empty, causing the pumps to draw more or less air into the system; or they may overflow, causing loss of brine. But even admitting with care these contingencies may be avoided, one has only to look at such a tank when in operation to see for themselves the æration of the brine which is continually going on, and the large head of froth which accumulates and through which the return brine splashes and sprays into the tank carrying with it no small amount of imprisoned air, which is directly pumped into the system and frequently causes trouble and annoyance, and an expenditure of both steam and temper before it can be got out again.

An accumulation of air pocketed in various parts of a brine pipe system greatly increases the force necessary to circulate the brine, so it is of importance from a steam-saving point of view and for wear and tear on the pipes to keep the system absolutely solid and free from air, and so that every part of the cooling surface does its full and proper work, and the whole works smoothly, regularly, and easily. So far from the closed system being more difficult to regulate, we have found the reverse is actually the case for the reasons given.

The brine piping should always be galvanized preferably inside as well as out. It is well worth the extra initial cost. Galvanized piping will be perfectly good after ten to fifteen years' service, and this without any attention whatever. There has been some discussion recently as to the advisability of galvanizing the piping inside. Calcium has a chemical action upon zinc, and this in an extensive brine-pipe system generates some amount of hydrogen gas, which if mixed with a large proportion of air is highly explosive. One or two accidents have occurred by the explosion of this mixture, which has led in some quarters to condemning pipes galvanized inside. We find by experience, even in ungalvanized piping, considerable gas is still formed, so that the absence of zinc does not by any means effect a cure. With the open tank system, the highly ærated brine not only favors the more rapid generation of hydrogen, but provides in an intimate mixture the air necessary to render the gas explosive.

With the closed system the brine is solidly circulated, and the generation of gas, even in galvanized pipes, is very limited, and, as just described, automatic means are provided for its escape as soon as formed, by way of a vent pipe and patent automatic trap. With such an arrangement it is impossible for gas to accumulate in any quantity, and equally impossible for it to escape into the refrigerator house, or where it could by any means become ignited.

The lecturer next drew attention to another arrangement of refrigerating machinery, one of the finest examples of an installation for north Atlantic work, as fitted on the latest Cunard and other steamers. Here, he said, are a number of compound duplex machines, which can work independently or collectively as required. The arrangement is such that each machine is connected to one chamber, each chamber having its own brine system and brine pump, and can, if necessary, be run quite independently of any other, and to suit the requirements of the particular shipment carried. The whole series of machines are cross-connected so that any one machine can work on to all the chambers. Each duplex machine is really two machines mounted on one base, the crank shaft being in two portions, and the cylinders so arranged that they can work together as a compound engine, or, separately, as high-pressure engines each driving its own compressor, or the compound engine can drive either one or both compressors. The gas condensers are two in number, entirely separate and contained in the box bed under the machine, but are cross-connected so that either compressor can discharge into both condensers, or both compressors into either one condenser.

The evaporators, six in number, together with the cold ends of the brine pumps, and the distributing headers, are enclosed in an insulated chamber and not individually lagged. The closed brine system is used throughout, and as some of the chambers are at a considerable distance from the machinery room a distributing house is arranged for these.

Mr. Brettell next described a new design of CO_2 compressor, which is radically different to those at present on the English market. This compressor has a loose liner, forming the working bore of the cylinder. This liner is of cast iron, and is held in an outer casing of special steel, which is bolted by means of feet cast solid with the casing down to the engine frame or box bed. The cylinder, therefore, has the advantage of a solid base and is not overhung. Two valve box heads are bolted by means of fitted bolts on to the casing, one at either end; these carry the suction and delivery valves which lift vertically and are without springs of any kind. The valves have each independent seats. The piston has no cup leathers, but instead is fitted with a series of cast iron packing rings which are very accurately fitted. The piston head is of novel construction, being in halves and having a collar which engages into a recess turned in the piston body. So long as the piston is within the cylinder nothing can possibly come adrift. A special form of stuffing box with an inner and outer gland is also used, cup leathers being entirely dispensed with. Another feature of the pump is that forced lubrication is quite unnecessary, ample and sufficient being provided by a simple syphon oil cup, which spots the oil drop by drop on to the rod.

Several examples of this compressor have been giving splendid results for some time past. The main object has been to do away with the disadvantages of leather cups and of forced lubrication whereby large quantities of oil are carried into the condenser and evaporator coils, and, in short, to produce a compressor which can be worked continuously during a voyage across the tropics or elsewhere, without the frequent necessity of stoppage to replace leathers in the pistons and glands. The makers claim for this compressor that it entirely overcomes these difficulties and is a thoroughly practical and efficient machine.

Very fair results are obtainable under favorable conditions, and with a good and well-arranged system of forced-air circulation, but with this system there is always at least three or four degrees difference between the ingoing and outgoing air, and in addition it is difficult to ensure that the air leaving the cooler shall always do so at the same temperature. With less powerful fans and indifferent insulation the temperature rise is very considerable, frequently 10 degrees or over, so that anything like an even and accurate temperature is impossible, the portion of the chamber nearest the outlet air being degrees warmer than that near the inlet air.

The brine-pipe system best lends itself to the maintaining of accurate temperatures, but in order to do this the cooling surfaces must be exceedingly large and evenly and well distributed over the whole of the chamber. It is rather a paradox that a very much larger cooling

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surface is required for the proper carriage of chilled beef at 29½ degrees Fahr. than is necessary for frozen mutton at 10 degrees to 15 degrees Fahr. The brine circulated must closely approximate to the actual temperature of the chamber itself, and in sufficient quantity that only a very small difference in temperature between the outgoing and returing brine is registered. By interlacing the several sections the average temperature of the cooling surface over the whole of the chamber can be absolutely equalized. The insulation must be of the best and of full thickness and sound construction.

With an ammonia machine it is possible to hold an outgoing brine temperature with perfect steadiness at any degree required, but with a carbonic-anhydride machine this is much more difficult.

When both frozen mutton and chilled meats or fruits have to be carried in the same ship, and by the same machine, some reliable means must be adopted whereby brine at a higher temperature than that required for the frozen meat can be provided for the higher temperature chambers. For this purpose some use has been made of a mixing tank to which is led a supply of the coldest brine. The brine from the high temperature chambers returns from this tank and is mixed there with more or less of the coldest brine, the mixture passes on to the brine pump, and is again circulated through the chambers and returned to the mixing tank. An overflow pipe is provided from the tank to the refrigerator or main return brine tank. This arrangement is only applicable to the open-tank system which we have already discussed, and I now wish to show you in diagram an improved attemperator working on the same general principle, in which the regulation of the supply of both colder and warmer brine is effected by one valve only. The arrangement is absolutely positive, and consists of a special valve box and mixing chamber; the movement of the valve in one direction opens the port to admit the coldest brine to the mixing chamber, and at the same time closes the other port to the admission of warmer brine. The total area of opening to warmer plus cold brine remains constant, no matter what position the valve is in, but the proportion of cold to warm brine is positively varied as the valve is turned, that is to say the warmer brine may pass through the attemperator without any addition of cold brine or the two may be mixed in any desired proportion until the warmer brine is entirely shut off and the cold brine only passes through. The coldest brine is taken from the feed pipe to the mutton holds and is always under superior pressure to the return brine from the chilled chambers so that the cold brine always displaces the warmer to the extent the valve will allow. An overflow pipe is carried from the return warmer brine main through a non-return valve to the evaporator so that the warmer brine which is displaced by the colder, returns to the evaporator. A thermometer with an open scale is fitted in the pipe beyond the mixture chamber to indicate the temperature of the mixed brine which passes on to the special brine pump and thence to the chilled meat chambers.

In the South American trade especially, it frequently happens that while the lower holds are exclusively used for frozen mutton, the 'tween deck chambers may be required for chilled beef or fruit, at a high temperature, and it is necessary to so arrange matters that any one or more of the 'tween decks may be used for chilled beef or fruit, or for mutton, as required. For example, on one voyage the whole of the 'tween decks may be loaded with frozen mutton requiring the same temperature as the lower holds; on another voyage chilled beef may be carried in these 'tween decks requiring a higher temperature brine; or perhaps one or more of the 'tween decks may be loaded with frozen mutton and one or more with chilled beef or fruit. To fulfil these conditions brine must be supplied at two temperatures, one for the frozen and the other for the chilled cargo, and means whereby any one chamber can be supplied with higher or lower temperature brine just as required.

Mr. Brettell then showed a neat and effective arrangement applicable like the attemperator, to the entirely closed brine system. As there are usually two 'tween decks forward and two aft, the diagram shows the headers arranged for two 'tween decks, though they are applicable to one or any number.

The brine feed and return headers are shown with the section pipes lead respectively to and from No. 1 and No. 2 'tween decks. Each header has a central longitudinal division, and a special three-ported cock is fitted at either end. The cold brine mains are connected, say, to the lower ends of the headers, and the warmer brine mains to the upper ends. By regulating the three-ported cocks, the cold brine can be either switched into one or both sides of the header, and thence to No. 1 and No. 2 'tween decks, or can be sent into one side only, or shut off altogether. Similarly, the warmer brine through the top end of the cock can be sent into either one or both 'tween decks or shut off at will. When the nature of the goods to be carried is decided, the cocks are set for the higher or lower temperature, and there is no further trouble.

Arrangements can also be made so that any one chamber or hold can, by the circulation of hot brine through the pipes, be thawed down and dried out in the course of three or four hours without in any way interfering with the working of the other holds or chambers in the ship. This is of great practical advantage where as soon as the frozen cargo is out ordinary cargo for the return voyage has to be loaded in.

To thaw out a hold in the ordinary way by simply leaving the hatches off, or in some cases by placing fires in them, or turning in hot steam from the boilers, is objectionable, and even dangerous. The snow on the pipes is partially melted and consolidated into a hard mass which is most difficult to get off, and the effect of either steam or fires upon the insulation is anything but beneficial. It is rather a curious fact, which is true at any rate of north Atlantic ships, that a chamber thawed out with hot brine, and thoroughly dried, is more easily cooled down at the end of the outward voyage preparatory to loading the refrigerated cargo; the reason being that the insulation boards and the chambers generally are in the one instance thoroughly dry, and in the other more or less damp or wet.

LLOYDS SHIP BUILDING RETURNS.

From the returns compiled by Lloyds Register of Shipping, it appears that, excluding warships, there were 569 vessels of 1,409,456 tons gross under construction in the United Kingdom at the close of the quarter ended June 30, 1906, as compared with 1,301,457 tons in the corresponding period of 1905. The tonnage under construction has shown a steady increase since December, 1903, and the present figures are within about 4,000 tons of the total reached in September, 1901, which is the highest on record. As compared with the return for December, 1905, the figures show an increase of over 53,000 tons, while the total for March, 1906, is now exceeded by about 7,500 tons. Of the vessels under construction in the United Kingdom at the end of June, 454 of 1,040,651 tons are under the supervision of the surveyors of Lloyds Register with a view to classification by this society. In addition, 56 vessels of 151,261 tons are building abroad with a view to classification. The total building at the present time under the supervision of Lloyds Register is thus 510 vessels of 1,191,912 tons.

Captain John McCarthy, who has been master of the whaleback steamer Bay City for the past two seasons, is now engaged ashore as landlord of the Dominion house, Sandwich, Ont.

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IMPORTANCE OF CAREFUL NAVIGATION.

Editor MARINE REVIEW:—The extraordinary rush which the demand for lake tonnage has recently inaugurated and the consequent demand for efficient officers and men to operate valuable steamers through the great lakes, where fogs and other hindrances prevail, as well as through the intricate channels and rivers connecting the lake system, is of course attracting the attention of the managers of steamboat lines, to an extent proportionate with the importance and magnitude that the industry has assumed. They are realizing as never before in the history of lake commerce that in grounding or by collision, or by any other form of accident, greater expenditure of money is necessary in wrecking and repairing, and greater loss by delay than in former years.

I have been gratified by the receipt during the last month of letters from two of the leading steamboat managers expressing their determination to contribute as far as is in their power to reduce accidents to a minimum, and my experience has taught me that the managers can do much along that line. I believe that the most fruitful cause of accidents is by far attributable to not sounding the passing signal early enough to receive a response that each vessel may know what course to pursue before they approach within dangerous proximity. A strict observance of the rule will practically insure safety in meeting and passing. I have been informed in a general way that the whistle rule is being violated very frequently and have taken occasion to say that if a specific charge of such violation is reported to any local office within the Ninth district it will certainly receive the attention that it deserves resulting in the suspension of the officer in charge when such violation occurs.

The fact the managers are moving along the line toward the highest degree of efficiency, not only in officers and men, but in equipment as well, is having its effect as shown in the written examinations of candidates who apply for marine licenses, as in almost every case the applicant has studied his lesson thoroughly with a full knowledge that the manager as well as the inspector is making diligent inquiry into the practical and theoretical knowledge of licensed officers.

Whatever tends toward safety in transportation in any form reduces the cost of the commodity transported, therefore less expensive at its destination, reflecting its benefits back upon the producer by way of increased demand from the same source, thus stimulating the vast opportunities of this country into active business enterprises and relations with other countries. The now pending subsidy bill, if passed, would surely tend to perpetuate indefinitely the condition.

Our steamboat managers, officers and seamen have come to be recognized as grand and important factors in shaping and fostering the future prosperity and history of our country as compared with other nations of the earth. It therefore behooves us who are in any way engaged in moving our products by the great lakes route to contribute individually so far as possible, our skill, our intelligence and our fidelity to any trust imposed or duty to which we may be assigned in carrying forward this work and in the spirit of true citizenship.

JAMES STONE,
Supervising Inspector.

Cleveland, July 26.

CAR FERRY ASHTABULA.

Marine men in Ashtabula harbor are taking a great interest just at present in the new Pennsylvania and Ontario car ferry Ashtabula because it is expected she will be given her trial trip very soon. Her contract speed is 15 miles an hour with thirty 50-ton cars aboard. She has made about fourteen without crowding, however, so she is expected to knock off the odd mile without any trouble.

The big boat is worthy of notice for two important reasons. Her excellent fit out is one, and the fact that she is manned entirely by young men, is another. From the captain down, the crew is composed entirely of young men. The captain, B. T. Haagenson, and the chief engineer, S. M. Sylvester, are excellent types of the younger generation of sailors.

Captain Haagenson is an experienced navigator who believes that a man cannot know too much. His luxuriously appointed quarters emphasize this because he has a well stocked library of nautical books, from "Wrinkles" to the Azimuth tables. He also has all necessary instruments.

The quarters for all the crew, including the seamen and porter, are on what might be called the promenade deck. The captain has two rooms, finished in quartered oak, and the forward crew have three other rooms. All the rooms are commodious and airy. The three guests' rooms or owners' rooms are in white enamel with mahogany and brass furnishings.

The captain has Mr. T. C. Smith as his first mate, and Mr. A. J. Buchanan as his second. Chief Sylvester has Mr. Thos. Elliott and Mr. Wm. Wenk as his first and second assistants. They are all fine types of young men and made out of the stuff that impels them to love their profession. Mr. C. H. Smith presides over the galley.

There is absolutely nothing lacking in the boat's equipment. She has intercommunicating 'phones, a Nicholson log that registers her speed as well as the number of miles covered, a condenser which can be connected with the pumps when slush ice is met on the lake, two watertight shaft alleys, and automatic fuel bunkers. Her steering engine is in the engine room.

The Ashtabula will carry thirty hopper cars. She makes the run to Port Burwell in three and three-quarter hours and is figured to make two round trips in twenty hours. She has a water bottom which can be filled or emptied in short order. It is divided up by bulkheads so that there is absolutely no danger of sinking by tearing a hole in her bottom.

WILLIAM M. MILLS.

One of the young men who has made rapid strides in lake commerce of recent years is Mr. Wm. M. Mills, of the Tonawanda Iron & Steel Co., North Tonawanda, N. Y. He is the manager of the Tonawanda Transit Co., the Niagara Transit Co. and the Weston Transit Co., as well as of the fleet of vessels controlled by the Tonawanda Iron & Steel Co. Last year the steamer Wm. A. Rogers owned by the Niagara Transit Co. broke the grain carrying record on the lakes and distinguished herself this year by opening navigation through the straits of Mackinaw, breaking her way through the ice in the rivers. The steamer Charles Weston, owned by the Tonawanda Transit Co., went into commission this spring. The three vessels which are now building for the Weston Transit Co. will be named Wm. M. Mills, Legrand S. De Graff and Wm. D. Kerr. These three vessels are to be the largest on the lakes, 605 ft. over all. Two of them will be built at Lorain and one at South Chicago. They will be ready by the opening of navigation next year.

For the first time since she became a prize of the Japanese blockading squadron the steamer Montana has arrived at San Francisco. The Montana was seized and condemned as a prize of war by the Japanese government but was subsequently sold to Robert Dollar, of the Dollar Steamship Co. Later the Montana was turned over to the Pacific Coast Steamship Co., the former owners of the vessel.

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THE MARINE REVIEW

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AUGUST 2, 1906.

OPERATION OF GASOLINE LAUNCHES.

Certain owners of gasoline launches have been durance vile during the past week. Congress during the last few days of its session passed an act regulating the operation of these craft. The provisions of the act, though mild in their character, appear not to be generally known and have therefore been violated through ignorance rather than intention. The law now requires the operator of a gasoline launch, carrying passengers for hire, to take out a license through the local board of steamboat inspectors. No examination is required to obtain the license, but it can be revoked for misconduct or failure to observe the rules of navigation. The local inspectors are therefore given a firm hold over the operation of the launches and at the same time the man who desires to operate his own launch is not prevented from doing so. Little sympathy need be wasted on a gasoline launch owner who violates the rules making for safe navigation. At the same time it would have been a hardship to the owner and a mortal blow to the industry to have required these launches to carry a licensed engineer or pilot. The launches are also required to carry one life preserver for each passenger carried. This is no more than right.

NOT COMMON CARRIERS.

Mr. Harvey D. Goulder, counsel for the Lake Carriers' Association, has submitted an opinion to President Livingstone and the members of the executive committee that the rate bill amending interstate commerce act passed at the last session of congress, and which goes into effect August 28, does not apply to the ordinary bulk freighter on the great lakes. He is of opinion, however, that it would be well to amend the bill of lading so as to make it absolutely clear that responsbility is assumed for the lake trip only. The opinion is as follows:

1. The ordinary bulk freighter of the great lakes, engaging her capacity as the owner sees fit, in any trade, with no fixed route, is not, in my judgment, a common carrier within the intent and purpose and definition of the law as declared in section 1.

2. The new law has a provision in section 7, which amends section 20 of the old law, directed to any "common carrier, railroad or transportation company," that the initial carrier on a through route shall be liable for loss or damage to a consignment up to its ultimate destination. Section 1 gives a rather wide meaning to the term "transportation," and it may be that if a through bill of lading is issued by the ship for a continuous carriage over several lines of carriers upon a through rate divided among the carriers, even a bulk freighter might be held to come under the operation of the amendment to section 20 referred to.

3. On the other hand, where the ship does not hold herself out to carry beyond her own lake delivery port, with no arrangement for a joint route, and there is no through rate with division among successive carriers, in my opinion there is nothing in the law to affect the bulk freighters, even in cases where there may be an ultimate further delivery intended by the shipping. The owner or agent of the ship should be careful to see that the billing on behalf of the ship (herein according with general practice, as I gather it), is only for carriage by the ship to the lake port of destination, preferably not consigned to another carrier; and that her freight rate is definitely expressed to be for her carriage only. It would be well to avoid any such general expression as "freight as per contract," and either express the lake freight, or at the most say, for example, "freight to Buffalo as per contract" or "lake freight as per contract."

4. I think it may safely be stated as the law that if the cargo is consigned to her lake port merely to the order of some party, the ship is not safe in delivering without production of the original bill of lading, and cancellation or receipt discharging the ship by someone authorized. Direction to notify some party is not a direction to deliver. Where cargo is consigned in care of a party, unless there is timely notification from the owner and holder of the original bill of lading to the contrary, delivery to the party in whose care the cargo is consigned is good delivery according to custom and reason.

5. A bill is in preparation by a committee of the Bankers' Association, in conjunction with the other interests, to establish a more definite practice than has heretofore obtained for safeguarding the shipper, the banker who makes advances and the carrier; in which, by invitation, the president and counsel are taking appropriate part. It is hoped that this legislation, which cannot be had before next winter, will make everything clear.

Until specific legislation can be had, in my opinion, this matter can be cared for in the manner above suggested with due safety to ship, bank and bulk freighter. A reasonable precaution by a bank advancing money would be to fix some agency in Buffalo, say its bank correspondent to which cargo is to be consigned or which is to be notified before any delivery. It is also important that the ship's copy of the bill of lading, though not negotiable, correspond exactly with the original bill.

PACKAGE FREIGHTERS AND PASSENGER LINES.

These, running between fixed termini and holding themselves out to carry generally for the public, are doubtless within the term "common carrier," as intended in the law; also as to their business upon through rates divided among successive carriers either for the carriage of passengers or goods, they must necessarily comply with its various provisions.

The only open question is as to the business which is in good faith local to their lines; for it must be understood that they cannot by any arrangement make actual through business local. It has been considered in respect to railroads, which are the special care of the law under consideration, that where a railroad, by reason of engagement in through routing and through rates, has come under the interstate commerce law, it comes under that law for all purposes of foreign or interstate traffic. This question is dealt with in section 2 of the new law, amending section 6 of the previous law. But as I construe that section in connection with the previous state of the law, I do not see any intent or provision for requiring the common carrier by water to bring within the operation of the law such of its business as is purely and in good faith local to its own line, even if this may in some cases be between different states.

LAKE TONNAGE.

The cry of too much tonnage on the great lakes is not new. It originated in 1874 when the V. H. Ketchum was launched and it has been sounded, if not yearly, at least biennially since. Yet the tonnage of 1874 would cut a sorry spectacle in the trade of today. Notwithstanding the numerous additions to the existing fleet during the past two years, it is doubtful if there is too much tonnage on the great lakes. The men who placed orders for ships for 1906 delivery early in 1905, thereby establishing a precedent, were wise men. There never has been a summer like the present one. In spite of the fact that dispatch is good, infinitely better than last year, both at shipping and receiving docks, shippers will not be able to move all the ore that they would like. A maximum movement of 38,000,000 tons was predicted. It will probably be a shade under 36,000,000 tons. The trade is characterized by great firmness and activity. There is no sagging, no lassitude, no customary summer quietude about it. Conservative owners are content with the volume and there is no apparent desire to force the freight rate. Grain, however, which is a subsidiary and incon-

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sequential trade in comparison with coal and ore, will pay a stiff advance and those that have ships to go into it will reap considerable profit during the fall months. The crop is heavy.

WHEELSMEN AND WATCHMEN.

The MARINE REVIEW begs to explain in connection with the competitive course of questions for wheelsmen and watchmen now running in its columns that the series will continue for about one year. No wheelsman nor watchman need hesitate to enter the contest on the ground that he cannot answer the questions. Before the contest is concluded ample information will have been published to enable any student to answer all of them. It is not necessary to answer the questions weekly. The answers may be deferred until the close of the season if desired. This course is projected upon practical lines and with the purpose in view of aiding wheelsmen and watchmen to advance on board ship. There is no doubt whatever but that owners are studying the younger element aboard ship narrowly. The future master is the wheelsman or watchman of today. The more proficient a man can make himself in his profession, the surer is his advancement. The wheelsmen and watchmen are advised to read Mr. Clarence E. Long's lessons carefully and to make note weekly of such questions as they cannot answer. By following it from week to week they will find that at the end of the season all things become clear.

FREIGHT SITUATION.

Vessel owners are taking their ease these days. Instead of hustling for cargoes as is common during midsummer, shippers are visiting their offices and thrusting cargoes upon them. There never has been a summer quite like it. It is customary to expect a slump about the middle of summer, but the trade was never in finer shape than now. There is constant inquiry for coal and ore tonnage. Vesselmen all admit that their boats at upper and lower lake ports are all getting good dispatch. Therefore, as the ore movement is not appreciably greater than that of last year while the available tonnage has been considerably augmented it must follow that coal shipments are unusually heavy. There are no reliable statistics in coal shipments to be had, but the signs point to a movement very much heavier than that of last year. The great bulk of the coal is moving at 30 cents to the head of the lakes and 40 cents to Milwaukee, though a contract extending over August and September has been made at 50 cents with the smaller class of tonnage for Lake Michigan ports. A differential of five cents has already been paid to Green Bay.

Grain cargoes are plentiful and offerings light. Consequently the rate has advanced, three cents being paid for the last half of September and the early part of October. Altogether, the conservative class of vessel owners are well content with the general situation.

AT THE HEAD OF THE LAKES.

Duluth, July 30, 1906.—The past week has been somewhat quieter in shipping circles. The ore movement has not been so large, shortages of boats being largely responsible, though no noteworthy falling off has occurred. Fogs in the rivers have bunched the boats a little and some of the coal docks especially were crowded during the last half of the week. There has been considerable activity in grain all week, though the demand for boats has been pretty well met by this time and one line is out of the trade entirely until fall shipments begin. The rate is strongly at 2¼ cents and one mixed cargo has been shipped at 2½ cents. At Duluth 3 cents has been done for shipments the latter part of September and the first of October, but the greater part of future contracting has been done from Fort William. Contracts for shipments later, at more than 3 cents, are purely speculative and it is believed that no move has been made to establish a higher figure. The shipment and receipts of grain from the head of the lakes for the past week are given as follows:

	Receipts.		Shipments.	
	July 21	July 28	July 21	July 28
Wheat	240,867	198,012	343,727	626,134
Corn	5,385	6,701	....	204
Oats	331,350	312,509	370,528	315,575
Barley	137,311	150,365	41,400	62,526
Rye	1,653	5,881	....	....
Flaxseed	497,676	505,323	804,166	426,149

As will be noted the figures are much the same for the past two weeks with the exception of wheat, the necessity for getting a quantity now at the head of the lakes away being responsible for an increase of nearly 300,000 bushels. Lumber shipments are regular, but there is a large amount of stock here yet to be shipped and it is probable that the rate, which has been $2.25 most of the year, will go up as much as a dollar by the middle of October.

An old boat famous in the passenger traffic of Lake Superior will soon be due again at Duluth in a new guise. The Jay Gould was built as a passenger boat in 1869 and was owned by Handy Bros. of West Bay City. In 1903 she was sold for a song and taken from Sault Ste. Marie to Bay City where her cabins were torn out and she was rebuilt as a lumber boat by W. P. Rattray, who is now sailing her. She is on her third trip and will soon be in Duluth to load lumber, of which she can carry about 800,000 feet, for Holahan & Whiting.

On Wednesday last the Eugene Zimmerman, which left the lower lakes for Duluth in April on its maiden trip, and was sunk April 14 by the Saxona in the St. Mary's river, arrived in Duluth. We have no record of any longer time being required to make the trip.

At midnight of July 26 the Henry H. Rogers cleared from Ashland with 12,914 tons of ore in her hold, loaded at the Northwestern dock in four hours. The Gary has a record of 12,242 tons.

The Great Lakes Dredge & Dock Co. has two dredges at work deepening the slip alongside the Northern Pacific dock No. 5 in the Duluth harbor and the dock will soon be ready for the handling of freight.

Capt. J. T. Lennon, of the lumber boat Holland, which overturned in the Duluth harbor, June 23, and which ran down the tug in the Detroit river last week, has appealed to Superintendent of Inspectors J. D. Sloan of this district for a return of his license which was revoked in connection with the Duluth accident. The opinion is expressed here that the action depriving Capt. Lennon of his papers will be rescinded.

The Mataafa has been placed in dry dock at Superior and the work on the Edenborn is proceeding slowly. The bottom on which the Edenborn rests is fairly level, but a raise of about eighteen inches between her and deeper water is being blasted away in a manner similar to the blasting at the "Crossing." Hydraulic jacks will be used in raising her.

Mr. Robert Aspin, superintendent of docks at the Illinois Steel Co.'s works, South Chicago, died at his home in Chicago this week. Mr. Aspin was seventy years old and had a wide acquaintanceship among marine men on the great lakes. Mr. Aspin invented the Champion ore hoists for unloading vessels which were used at the South Chicago plant for twenty-seven years, being but recently superceded by the automatic clamshells.

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GAS ENGINES FOR SHIP PROPULSION.*

BY J. F. THORNYCROFT.

At the spring meetings of the Institution of Naval Architects in 1904, the use of gas engines was referred to in a paper read by the author on "Internal Combustion Engines for Marine Purposes." At that time there was practically no information available with regard to them, but just then Herr Emil Capitaine was carrying out experiments with his first boat, and a number of vessels have since been fitted which have shown very satisfactory results, and it is thought that a description of them, and particulars of the results obtained will be of interest to the institution, Sir William White having recently stated that he considers the gas engine will be bound to play a most important part in marine engineering.

Before giving details of the different vessels, it may be well to shortly describe the way a gas engine works in conjunction with a gas producer, and consider the possible advantages and some of the difficulties that have to be overcome.

The majority of small gas engines work on the "Otto" cycle, which has the advantage of requiring no special gas or air pumps, and this is the only type of engine that has been as yet tried for marine work. The gas producer which is generally used for moderate powers works on what is known as the "suction" principle; that is to say, instead of the gas being generated by the combustion of fuel, by air and steam being forced through it under pressure, it is generated by the air being drawn through the producer, the whole of the apparatus working somewhat below atmospheric pressure. The advantage of this system is that neither a steam boiler working under pressure, nor a gas container for holding the gas is required, and the further very important advantage for marine work is that there is no danger from a leakage

*Read at the spring meeting of the Institution of Naval Architects.

Fig. 1.

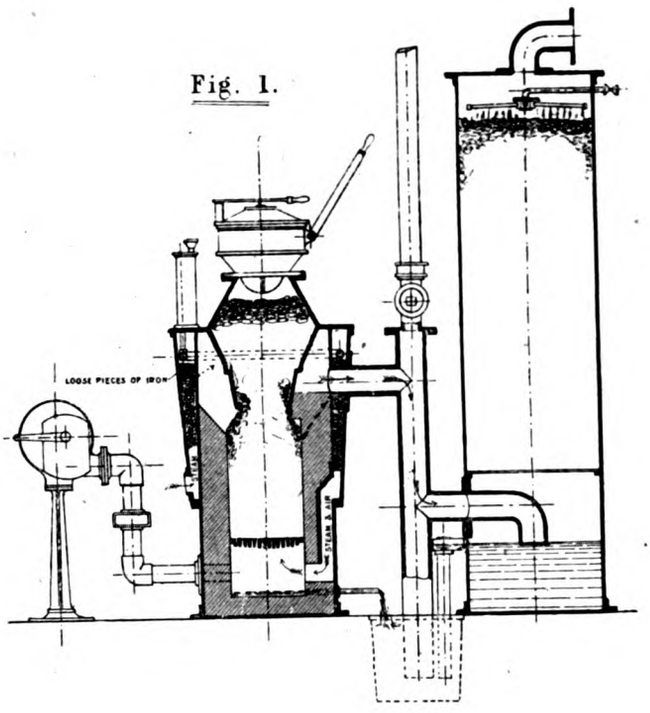
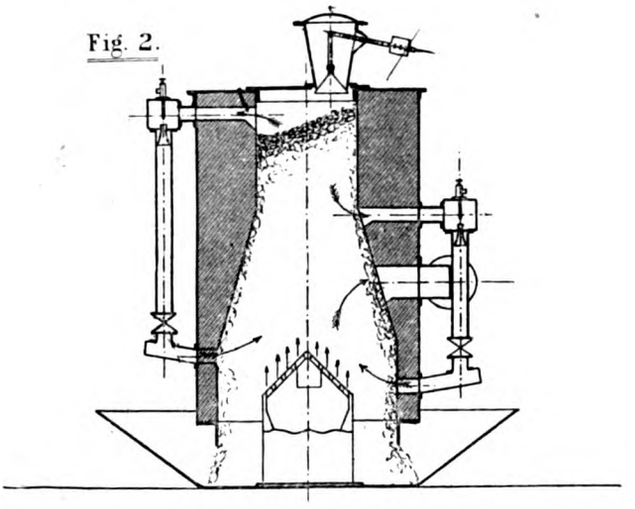


Fig. 2.



THE "DOWSON" GAS PLANT. SUCTION TYPE.
THE "DUFF-WHITFIELD" GAS PRODUCER.

Fig. 3

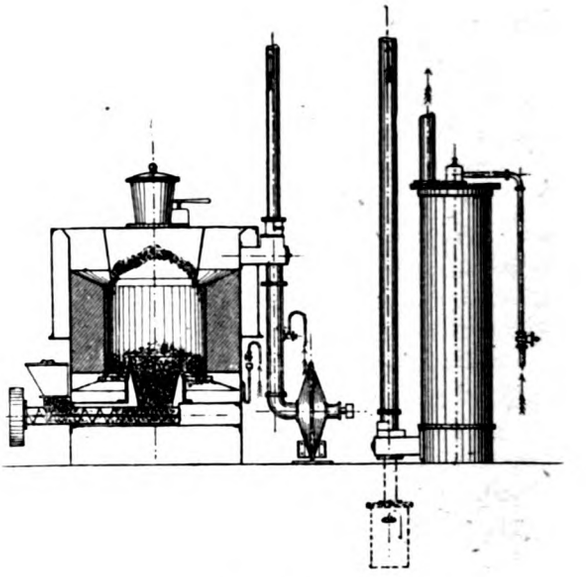
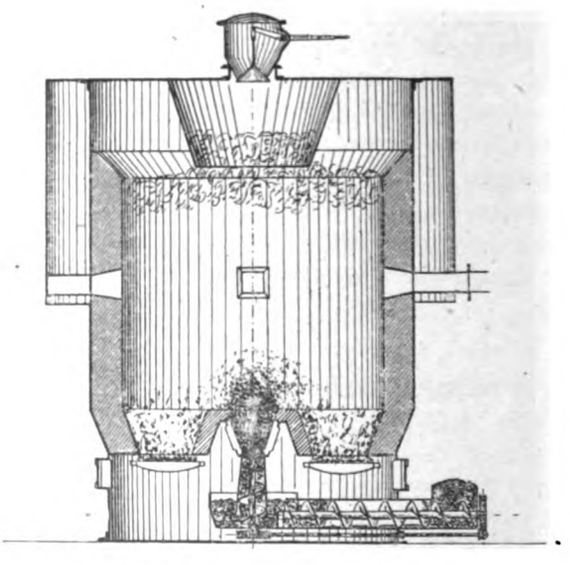


Fig. 4.



THE "BOUTILLIER" SUCTION GAS PLANT.
SUCTION GAS PLANT. WITH AIR SUPPLY FROM BOTH TOP AND BOTTOM.

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of gas from the producer; if leakage takes place, it is from the atmosphere into the producer itself.

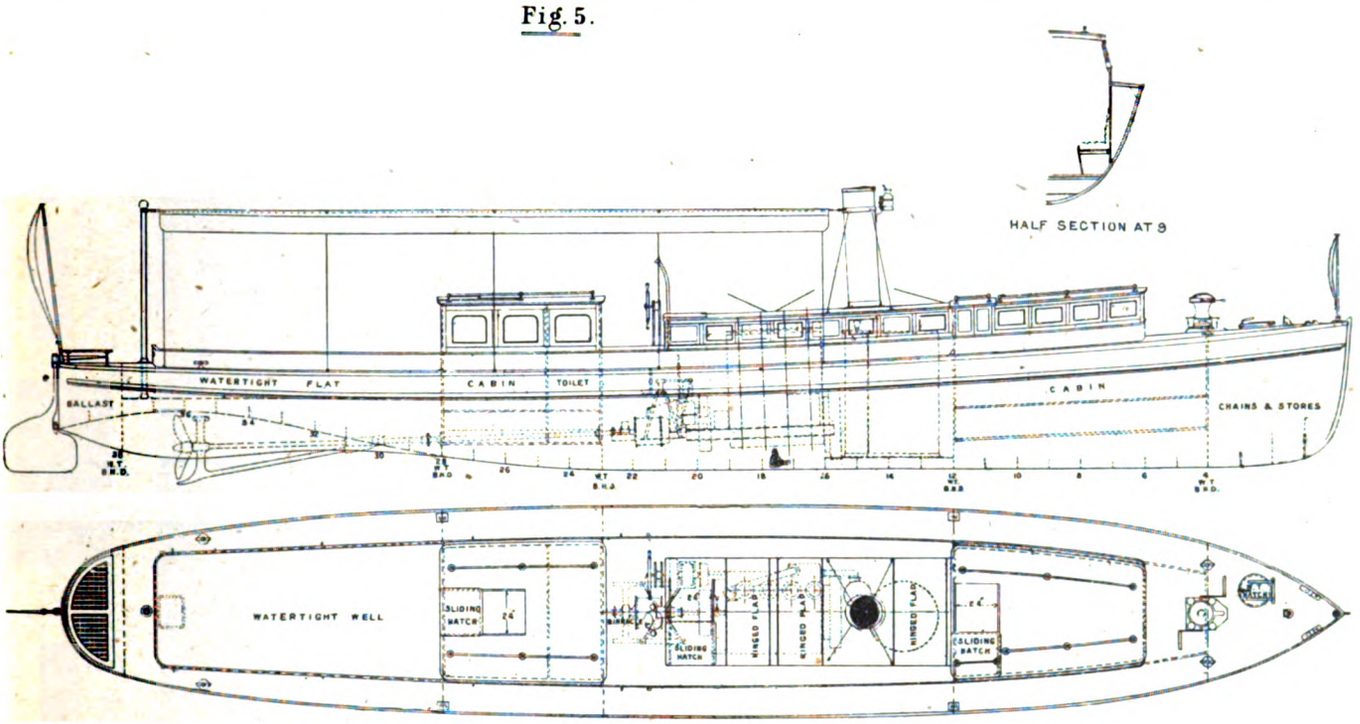
There are so many combined plants consisting of a gas engine working in conjunction with a suction producer at work for stationary purposes, that it might appear only very small alterations would be required in these plants to adapt them for marine propulsion; but in addition to the great difference between almost all marine and land plants, viz., that of the quick and frequent variations of load which the smaller types of marine plants have to undergo, there are very many features which must be changed to adapt the gas engines and producer for boat work. In fact, it will be found that the principle of operation will be about the only thing which can be identical with the land plant; the details of the apparatus all having to be specially worked out for the new conditions.

The producers for moderate sized powers are usually worked with anthracite coal, and where vessels are to be used on fixed routes, and the same class of fuel can always be obtained, anthracite or coke will be found to be the most suitable for moderate powers, it being too difficult to make a satisfactory small plant to work with bituminous coal.

For larger powers, and for vessels that have to take up fuel at different ports, the producer must be capable of dealing with coal, other than anthracite, which may be of a tarry or caking character.

The design of the producer capable of successfully dealing with bituminous or caking coal is a much more difficult problem than the anthracite producer. There are, of course, very many large land installations of pressure producers working with bituminous coal, but the apparatus for extracting the tar and other by-products, as at present arranged, is far too cumbrous for marine work, and the marine producer to deal with this class of coal must be designed on entirely different lines, being arranged to consume the tar which is evaporated off from the coal in the first stages of its heating. This has been arranged in some producers by taking the gas off at a comparatively hot part of the fire, instead of at near the top of the new coal, as is usually the case with the anthracite producer, but there are plants now at work dealing successfully with bituminous caking coal, which are fed by an undertype stoker, so that the new coal is forced into the hottest part of the

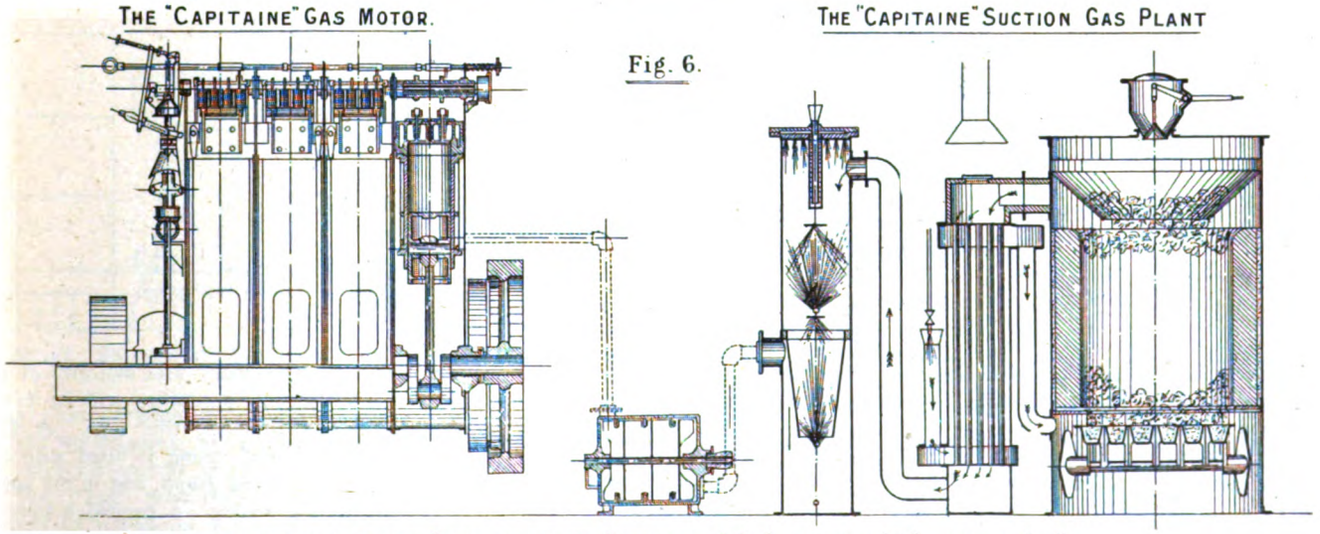
Fig. 5.



THE "CAPITAINE" GAS MOTOR.

THE "CAPITAINE" SUCTION GAS PLANT

Fig. 6.



GAS MOTOR LAUNCH "EMIL CAPITAINE." LENGTH 60′ 0″. BEAM 10′ 0″. DEPTH 4′ 9″.

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fire, and the tar which is driven out is at once burned.

After the gas leaves the producer, it must be first cooled, and, as there will always be a certain amount of impurity, even when anthracite is used, it has to be thoroughly cleaned. This is usually done by passing the gas through a series of vessels where it is scrubbed by its passage through layers of coke over which water is running.

It is frequently arranged that the cooling of the gas is affected by passing it over a water-containing vessel, which acts as a generator for the steam required by the producer; but there are disadvantages in this method where the producer is not working at a uniform load, as the steam will not be generated until the producer has been working some time, and will continue when the engine has been stopped, and when it is not required, and so cool the fire, causing the gas to be poor when the engine is again started, after the temporary stoppage has taken place.

The large space occupied by the ordinary coke scrubbers prohibits their use for marine work, and to meet this difficulty Herr Capitaine has arranged his plant to clean the gas after it has been cooled, by the introduction of a very fine spray of water, which mixes with the small particles of dust and other impurities in the gas, and forms a sort of fog; the gas in this stage is passed into a centrifugal apparatus, having a peripheral speed of 160 ft. a second, which throws out the moisture and impurities, leaving a clean dry gas to be drawn out by the engine.

The composition of this gas may be taken to be about as follows:

Carbon dioxide	6 per cent
Carbon monoxide	25 per cent
CH_4, methane	1 per cent
Hydrogen	14 per cent
Nitrogen	54 per cent

It will be realized that the size of the producer for a given power is comparatively small when it is known that the area of the fire grate necessary is only 0.05 sq. ft. per horsepower, whereas the average for an ordinary natural-draught steam boiler, burning 15 lbs. coal per square foot grate area, would be 0.2 sq. ft. per horsepower.

The depth of the fire will vary considerably with different qualities of coal used, but will not be usually more than two or three times the diameter of the fire grate.

DESIGNS OF DIFFERENT TYPES OF PRODUCERS.

Fig. 1 shows Messrs. Dowson's arrangement of suction producer designed for anthracite coal. The majority of the smaller suction producers will be found to closely resemble this type. A firebrick lined steel casing is fitted with fire bars and a closed ashpit, and in the upper part of the casing a conical hopper is placed with the usual valves for opening and closing to admit fresh charges of fuel. The gases come off the fuel at the base of the conical hopper, and pass through a steam generating pipe or vessel, and then away to the cooler and scrubber. The producer is fitted with an outer casing in which the air is heated, and mixes with the steam on its way to the ashpit.

Fig. 2 shows the Duff-Whitfield producer arranged for working with bituminous fuel. In this producer, the tarry products which are evaporated off from

Fig. 7.

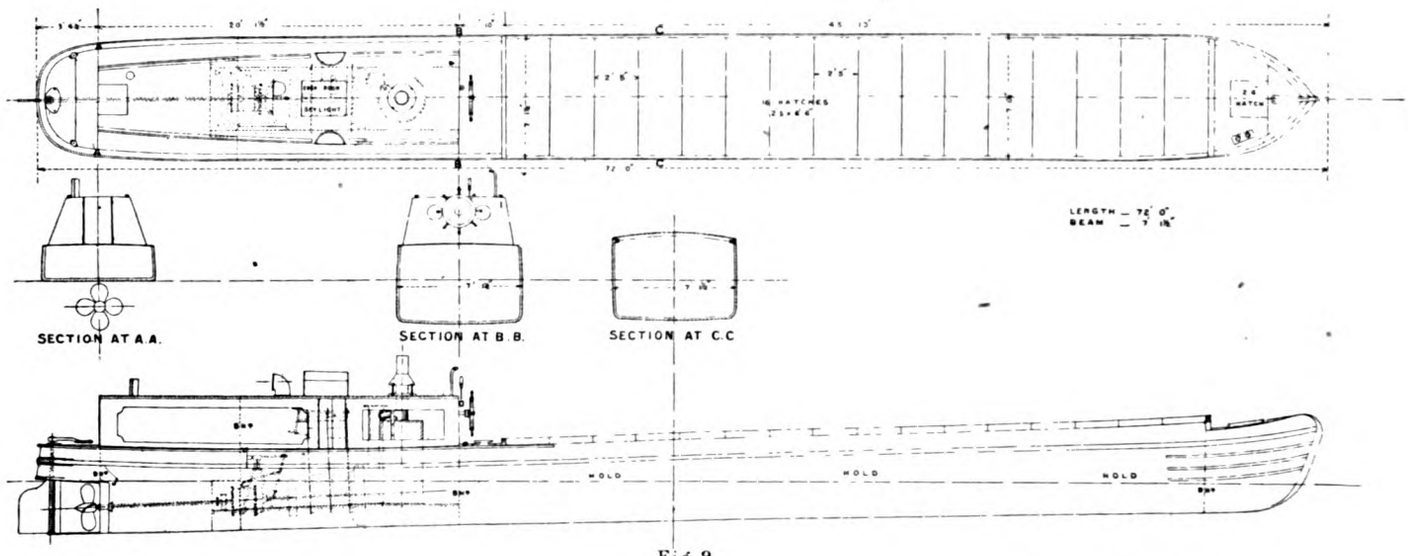
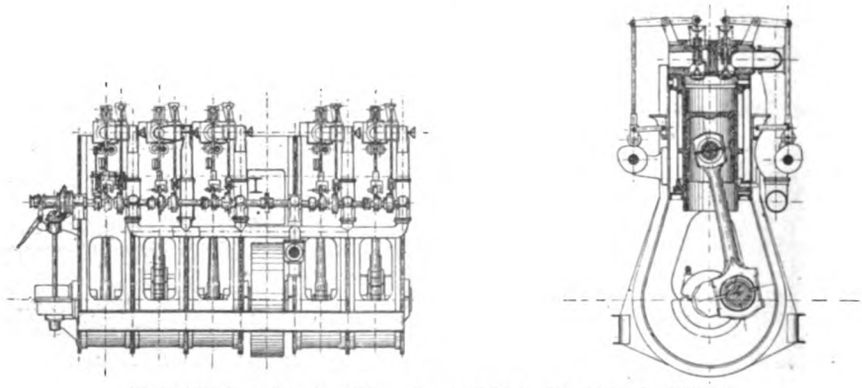


Fig. 8



PRODUCER GAS PLANT. AS FITTED IN CANAL BARGE.
20" x 24" FIVE CYLINDER GAS ENGINE. 500 HORSEPOWER.

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the new coal are caused to pass through the hottest part of the fire, and so are consumed before the gas passes away to the cooler.

Fig. 3 shows the "Boutillier" producer arranged for working with bituminous fuel, in which the fuel is supplied by an undertype stoker to the hottest part of the fire, so that the tar is at once decomposed, and cannot pass away with the gas. The principle upon which this producer works seems to be one of the best adapted for marine work.

The "Jan" producer consists of a series of producers which are arranged to work in sequence, the gases of one which has been newly charged passing through another which has been at work some time, so that there are always some of the producers supplying tarry gas, the tar being consumed by one of the other producers in the later stages of the series.

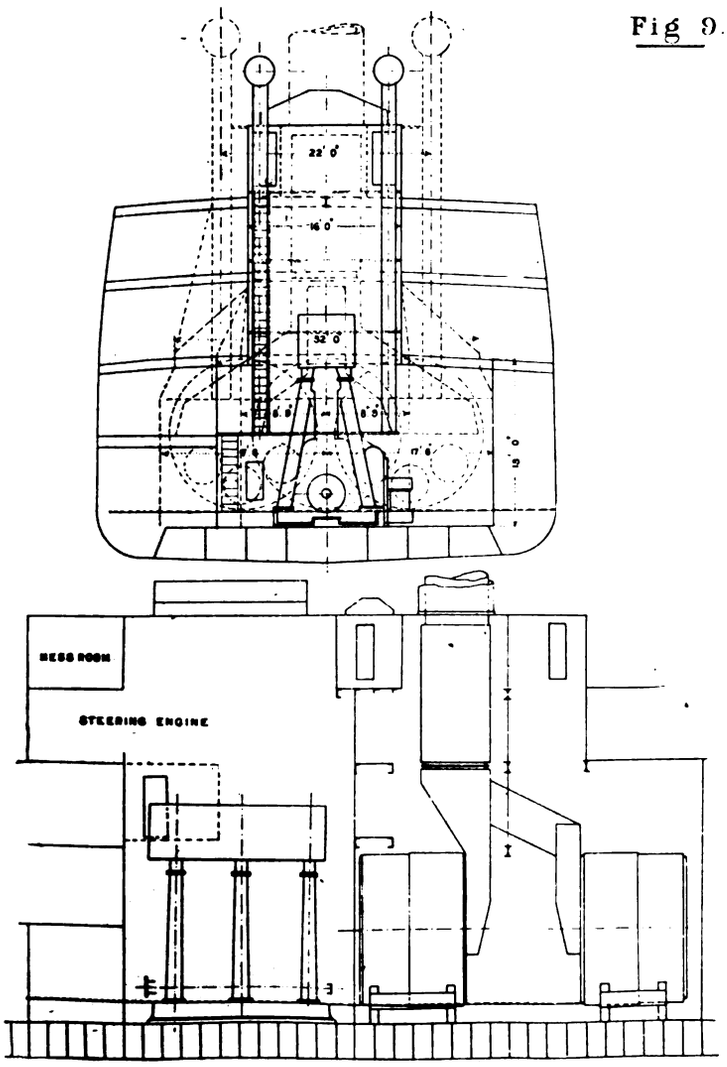
The heat losses in the producer itself are very small, as the whole plant can be so thoroughly lagged that practically there need only be heat passing away with the gas that is being generated. The loss from this cause may be very much reduced by using it to heat the air supplied to the producer.

The heat efficiency as given by Messrs. Dowson for their suction plant is 90 per cent. As the result of a great many tests, the late Mr. Bryan Donkin gave the average heat efficiency of steam boilers at 66.7 per cent.

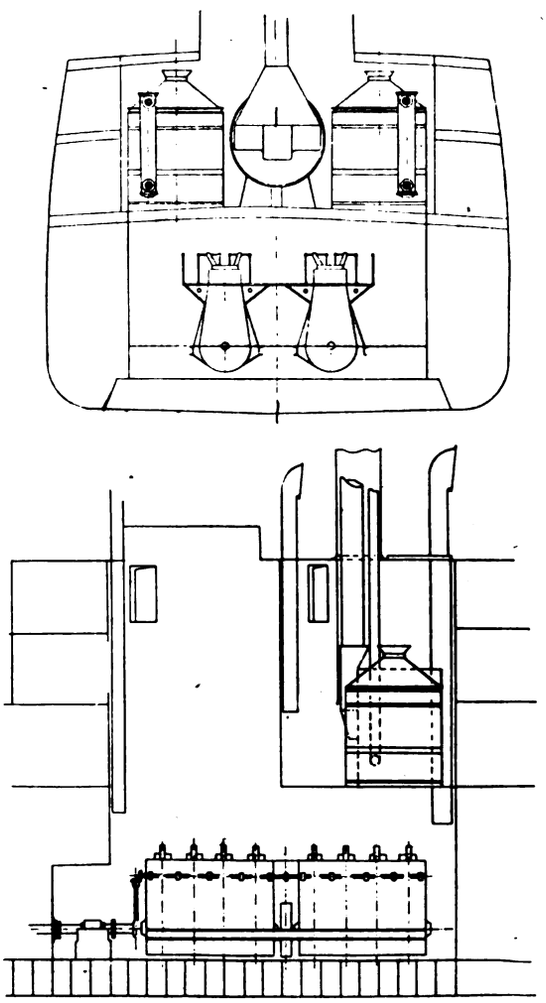
To start up the Capitaine producer, a fire is lighted on the bars, and the producer is then filled with fuel, air being either drawn or blown through it by a hand or power-driven fan. For a producer of about 50 to 100 horsepower, twenty to thirty minutes should be sufficient to give good gas. This can be ascertained by lighting the gas which is being given off, and seeing that it continues to burn with the right sort of flame. The gas first produced will have very little hydrogen in it, and will not be very powerful, and requires the steam generator to come into operation. The steam which is added to the air entering the producer strengthens the gas by the water being decomposed, and gives the percentage of hydrogen which is shown in the analysis above referred to. The gas produced in this way is of a comparatively slow-burning nature, and may be described as poor gas, to distinguish it from town gas, and some of the other gases generated by pressure producers which have a larger proportion of hydrogen, such as water gas.

There is an advantage in this slow-burning gas, as it enables the engine to work with a high compression, thus giving a larger range of expansion and consequently a high economy. The slow-burning nature also avoids the violent shocks which occur when more powerful gases are used, and so a smooth-running engine is obtained. The producer once being set to work will continue to generate gas in large or moderate quantities as the engine requires it and sucks it from the producer. The producer will probably be giving the best gas at somewhat near its full capacity, but will continue to give good gas down to a small proportion of full load. At very light loads it is difficult to keep the fire hot enough to produce good gas, and special means

Fig 9.



SPACE REQUIRED FOR 2,000 H. P. MARINE ENGINE AND BOILERS.



SPACE REQUIRED FOR 2,000 H. P. GAS ENGINES AND PRODUCERS.

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have to be adopted to keep the producer hot enough on these occasions.

Having now generally described the producer, the difficulties and advantages of adapting the gas engine itself to marine work will be considered.

The one great disadvantage of the internal combustion engine is the necessity of setting the engine in motion before it will run automatically. For powers less than 200 horsepower, it is preferable to employ a reversing gear, keeping the engine always running in the same direction, or to use a reversing propeller. Compressed air is being employed for starting up large engines, and when once the engine is fitted in this way, the valve gear for running the ergine in either direction does not amount to very much.

For moderate powers, a single acting engine with a trunk piston is found most convenient, as the piston does not require to be water-cooled, until one as much as about 2 ft. in diameter is employed. A single cylinder of 20 in. diameter and 2 ft. stroke, running at 120 revolutions per minute, will give about 100 horsepower, taking the average working pressure at about 80, which is less than the figure often obtained.

The same sized cylinder, working as a double-acting cylinder, would, of course, double the horsepower; but, besides the additional valves, which must be an exact duplicate of those required for a single-acting engine, there is the complication of the water-cooled piston and rod. This at first sight will appear somewhat serious to the marine engineer, but when the very large number of engines of this design which are working on land are considered—the regularity with which they are run, and the little attention they require—it will be agreed that there does not seem any reason why they should not meet with success at sea.

For small plants of from 100 to 200 horsepower, a small auxiliary internal combustion motor, driven by oil or some other fuel, is found most convenient for blowing up the producer, for starting it, and also for starting the main engine.

For larger powers fitted to vessels where steam capstans and steering gear are fitted, it is thought that the best plan will be to employ an auxiliary boiler, which can be heated by the gas when the whole plant is at work, and can be used independently to drive the various auxiliary and starting engines when the producer is not alight.

The average heat efficiency of steam boilers is taken at about 66 per cent.

Professor Capper has stated that the theoretical maximum thermal efficiency of the steam engine is only 30 per cent, and only from 5 per cent to 20 per cent of the heat generated is ever turned into useful work. In the case of the gas engine, the theoretical efficiency is about 80 per cent, and in practice 25 per cent to 30 per cent of heat developed in the cylinder is turned into useful work.

For vessels fitted with small powered compound-condensing engines of less than 100 horsepower, the fuel consumption will be from 2 to 3 lbs. per I.H.P. For gas plants of this power the fuel consumption will be less than 1 lb. per I.H.P. For larger powers of not less than 500 horsepower the economy will not be quite so marked, but will be about as follows:

Steam plant, say, 1.6 lb. per I. H. P.

Gas plant, say, 0.8 lb. per I. H. P.

At this figure of one-half, the gas plant should be well worthy of adoption from an economical point of view, as, in other words, the same coal will do double the work.

The stoking and the cleaning of the fire of the producer are much less than would be required for a steam boiler of the same power, the stoking being practically automatic, and practically the whole fuel other than the clinkers is consumed.

From the plants made, and from designs that have been got out for moderate powers, it would appear that the space occupied by the gas generator and engine is about the same as the steam plant; but for large powers, where a double-acting gas engine is employed, the weight will be considerably less, as the engine will be about the same weight as the steam engine, and the producer will be very much lighter than the boiler.

The type of engine adopted by Herr Capitaine for his small powers is built with a plate frame, no casting being employed in the engine other than the cylinder itself. A light engine is thus obtained, and there is no danger of breakage resulting from the very high pressures employed. Figs. 5 and 6 show the engine fitted to the vessel which ran in the reliability trials in the Solent last summer, which was named Emil Capitaine, after the inventor of the system.

The official report of the trials shows that this boat of 16 tons displacement ran at an average speed of 10 miles per hour for 10 hours, on a consumption of 412 lbs. of anthracite coal. This consumption also includes the fuel which was consumed by the producer during the previous 12 hours, when it was not in active operation, but simply smoldering and keeping itself alight, the producer having been filled the night before the trial. The amount of fuel consumed in this way is very little, but should be taken into account when making a consumption trial.

Several tugs, boats and other vessels have been fitted with similar engines to the one illustrated, and are at the present time running on the Continent on the inland waterways; but, as far as is known, the Emil Capitaine was the first vessel fitted with a gas engine and producer to run in the open sea.

For the purpose of comparison, tests were made on November 8, 1904, with the Gastug No. 1 and Elfriede, a steam tug of very nearly the same dimensions and power. The Gastug No. 1 is 44 ft. 3 in. long by 10 ft. 6 in. beam, and is fitted with one of the 4-cylinder 70 horsepower suction gas plants. The Elfriede is 47 ft. long by 12 ft. beam, and is fitted with a triple-expansion steam engine developing 75 horsepower. At the towing meter the Gastug No. 1 attained a maximum pull of 2,140 lbs., and the Elfriede a maximum of 2,020 lbs. A run from Hamburg to Kiel and back was made by these two boats, during very stormy weather, at a maintained speed of 8½ knots. The consumption of fuel was measured for a period of 10 hours, and was as follows: For the Gastug No. 1, 530 lbs. German anthracite; for the Elfriede, 1,820 lbs. steam coal. This shows an economy of 1 to 3.44 in favor of the gas plant.

Messrs. Deutz, the well-known gas engine builders of Cologne, have fitted one of the large Rhine barges with two of their two-cylinder land type engines and producers. The vessel is of 200 tons carrying capacity, and is said to have given satisfactory results, running on the Rhine between Rotterdam and Cologne.

CANAL BARGE.

To determine the suitability of the Capitaine system for small powers, a canal barge (Fig. 7) has been fitted with a two-cylinder 35 horsepower engine, and it has been sent on an extended trip over the English canals. She left Brentford in charge of Mr. B. Dunell on January 3, fully loaded herself, and towing two ordinary canal barges, which she took to Birmingham. After giving various demonstrations there, she proceeded to Manchester, and after making further trials there, worked her way back to the Thames at Oxford, returning to Chiswick at the end of February. The total fuel consumed on the round trip, and the various demonstration runs she made at the different places, was 5 tons 1 cwt., the engine having been under way for 40 days.

The only difficulties experienced on the trip were due to the shallowness and the bad state of many of the canals; the water inlets on several occasions becoming choked with mud, and the propeller, which was of the reversing pattern, damaged by coming into contact with different sorts of rubbish, which had been allowed to accumulate in the canal bed. It would appear that the only sort of propeller suitable for canal work

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is one of the strongest description, made of steel, which can be relied upon to bring up the engine, if necessary, without damage to itself when striking large stones, or getting jammed up with old ropes. The particular barge to which this machinery was fitted was originally built to be propelled by steam, and it is interesting to note that a considerable gain has been effected in cargo space by the substitution of the gas plant. In addition to the high economy which can be obtained with the gas plant for canal barge propulsion, there is the great advantage over the oil of absence of any smell; an objection which the barge owners state prevents the adoption of the oil motor for their work, as the cargo they frequently carry would be damaged by taking up the smell of the oil.

It has been suggested that the exhaust from the engine would be dangerous in passing through canal tunnels. No difficulty from this source was experienced, and, indeed, it is difficult to see why there should be any more danger than from the carbonic acid gas given off by the boiler of a steam barge.

To demonstrate the possibility of using gas plants for large powers, Messrs. William Beardmore & Co., who are joint owners with the author's firm of the British Capitaine patents, are constructing sets of engines (Fig. 8) of 500 and 1,000 horsepower, to run at a speed of about 130 revolutions per minute. The 500 horsepower set is generally of similar construction to the smaller sizes, the framing consisting entirely of steel plates arranged to transmit the stresses directly from the crank shaft bearings to the cylinder heads. Cam shafts for operating the inlet and exhaust valves are placed on either side of the cylinders, the valves being operated by rocking levers, so that, when the cylinder head is removed, free access can be obtained to withdraw the pistons. The 500 horsepower engine consists of five cylinders, each capable of developing 100 horsepower. The reason for adopting this size of unit has been that the largest piston is being employed which it is thought safe to use without water-jacketing it. The 1,000 horsepower engine has the same diameter and stroke of cylinder, but the engine is double acting, and the pistons are necessarily water-cooled. These large engines are started by admitting compressed air or gas through special starting valves, and reversing is effected by an arrangement for shifting the cams for operating the valves to the right relative position for running the engine in the opposite direction. Compressed air or gas is admitted to make the engine give the first few revolutions in the required direction, the engine being uncoupled from the propeller shaft by means of hydraulic clutch or coupling for the short time while reversing is taking place.

Two systems of ignition are fitted, one of the low-tension magneto type, and the other of the high-tension lodge system. The cylinders and the various bearings are lubricated by a system of forced lubrication, a distributor giving a full pressure of oil to each bearing in turn.

The producers for these engines are arranged to work with bituminous fuel, the producer being stoked from the top, and the gas drawn off from the hottest zone of the producer. The green fuel on the top is pre-heated by the hot coal underneath, and the tarry products carried through the incandescent fuel. A special feature of the producer is the arrangement for preventing the caking of the fuel and the formation of cavities, which are so difficult to avoid when bituminous fuel is employed.

As some of the most important parts of the new producers are not yet fully protected, further details cannot at present be published.

In the first experimental vessels to be fitted with these large engines, the usual "donkey" boiler will be retained for the purpose of working the steering and other auxiliary engines, and for working the compressors for starting up the engines, when the plant has been some time at rest. When under weigh, these boilers may be heated by the gas from the producer.

Fig. 9, shows the machinery space of the 7,000 ton cargo steamer recently constructed by Messrs. Beardmore & Co., Ltd., and an alternative arrangement which has been got out by Mr. W. W. May (Messrs. Beardmore & Co.'s engineer) to fit vessels of the same power with gas engines and producers. With this arrangement a saving of 13,000 cubic feet of cargo space is effected, besides a considerable gain in weight. It will be seen that the producers themselves are so small that they can be placed partially above the engines.

It has been suggested that trouble would occur from the poisonous gases from the producer in the confined spaces on board ship, but, if proper ventilating arrangements are made, there should be no trouble from this cause; indeed, the crew of the gas barge already referred to frequently slept in the producer-room during the trial, which was conducted in very cold weather. Although this course is not to be recommended, it indicates that there need be no danger.

There are many instances of gas engines running for stationary purposes for long periods on town gas without a stop of any sort.

With a view of ascertaining what results may be expected with producer gas, inquiries have been made of a number of large gas engine manufacturers, and it appears that there are many engines of 250 to 400 horsepower per cylinder running regularly every week from Monday morning to Saturday afternoon without a stop. The Premier Gas Engine Co. give an instance of an engine which has made a run of fifty-one days without a stop, the previous run being forty-nine days without a stop of any kind.

From the various physical changes which take place within the cylinder of an internal combustion engine, it is evident that it cannot well compete with the steam engine as far as continuous running without cleaning and adjustments are concerned; but, from results that are being obtained in everyday use, it is submitted that the reliability is now so good there need be no hesitation in adopting them on this account.

SHANGHAI-VLADIVOSTOK ROUTE.

It is stated on what is regarded as reliable authority that the former White Star Liners Doric and Coptic, recently purchased by the Pacific Mail Steamship Co., are to be placed on the run between Shanghai and Vladivostok. The company carries a vast amount of freight from San Francisco to Shanghai, where it is transferred to another line. Several vessels are carrying freight to Siberia out of Puget Sound, and it is stated that the Pacific Mail Steamship Co. has been compelled to establish a line in order to meet the competition. The officers of the Doric have received orders from the home office in Liverpool to proceed to England at once. But the Pacific Mail company has found it is impossible to pick up men with British papers at a moment's notice, and the White Star Line has been appealed to for sufficient men to make another voyage on the steamer. It is probable that the present officers will take the Doric to the orient, where others will be obtained.

The cruiser Milwaukee, built by the Union Iron Works, San Francisco, underwent a standardizing trial last week and reached a speed of 22.25 knots. The cruiser was not especially favored by the elements as a heavy sea was running, but she maintained this speed for half an hour at a time. She is now undergoing her government trial and will doubtless have very little difficulty in maintaining the contract speed of 22 knots. The navy department has been notified that the armored cruiser California will be ready to undergo her government trial about the middle of August. She will probably be commanded by Capt. Thos. Phelps.

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AROUND THE GREAT LAKES.

Coal shipments from the port of Erie are unusually heavy this year.

The steamer Major, which grounded on a sand bar near Madeline island was released without damage.

The big steamer Weston, which stranded on Keweenaw point near Copper harbor on Friday last, was released without material injury.

The steamer Isaac L. Ellwood, of the Steel Corporation's fleet stranded in a fog on Cedar reef, but was released after lightering 200 tons of ore.

The steamer Denver, formerly owned by the Milwaukee Dry Dock Co., is to be converted into an elevator dredge for the Daly-Hannan Dredging Co.

The tug Ben Campbell which was tied up at the Great Lakes Towing Co.'s dry dock was struck by a scow Monday night. She filled and went to the bottom.

The first of the six steamers which the new Ontario Steamship Co. of Hamilton, Ont., has ordered from abroad, will come to the lakes in September.

The new steamer W. G. Pollock left Cleveland on Saturday last on her maiden trip up the lakes. Capt. H. G. Haybarger is master and Edward Riley, chief engineer.

R. Burgess, who has been mate on the steamer R. S. Warner, will go as mate on the steamer L. C. Hanna with Captain M. Anderson, who was shifted from the Warner to the Hanna.

Since May 10, when she put in at Conneaut on her first trip down, the steamer Rensselaer has made nine trips from Lake Superior ports. She is commanded by Capt. S. C. Allen.

The steamer J. B. Cowle while entering the port of Ashtabula last week pushed her fan tail through the side of the Upson-Walton building, damaging the building slightly and displacing considerable of the stock.

William Frost, of the younger generation of lake mariners, has been promoted from a wheelman's to a second mate's berth by the recent changes in the Hanna fleet. Mr. Frost is second mate on the steamer R. S. Warner.

Capt. Fred Leckie, of the firm of Goulder, Holding & Masten, has been appointed treasurer of local lodge No. 4, Ship Masters' Association, to fill the unexpired term of the late Capt. Thomas Jones.

Mrs. B. T. Haagenson, wife of Capt. B. T. Haagenson, master of the carferry Ashtabula, left for the upper lakes last week on the steamer Frank H. Peavey. Her father, Capt. Tappan, is master of this ship. The Peavey cleared from Ashtabula.

The steamer Norman B. Ream, building at the South Chicago yard of the American Ship Building Co. for the Pittsburg Steamship Co., will be launched about the middle of August and will be sailed by Capt. A. C. Chapman. Capt. Chapman is at present on the Malietoa.

Harry G. Anderson, a bright young wheelsman on the Empire City, got off his boat on the down trip to Ashtabula last week on account of the death of his father at Sand Beach, Mich. He hurried home to attend the funeral services, and will catch the boat on the down trip.

Mr. Gus Johnson, formerly chief engineer of the Neilson, of the Pittsburg Steamship Co.'s fleet, has resigned and Mr. Wm. P. Diamond has been promoted from the Cambria to the Neilson. George Barth, formerly assistant on the Fairbairn, has been promoted to chief of the Cambria.

Clarke Byers, of Detroit, who has been acting as second mate on the steamer B. F. Jones since she came out, will be given a mate's berth on that ship when Capt. F. G. Simmons leaves her to take charge of the new Becker steamer, Joshua Rhodes. Capt. Simmons has been acting as mate on the Jones.

Mr. Louis C. Sabin, secretary of the American section of the International waterways commission, has tendered his resignation. He has been appointed superintendent of the St. Mary's Falls canal to succeed Supt. Joseph Ripley who has been selected as one of the Panama canal engineers by President Roosevelt.

Wm. P. Diamond, chief engineer this season on the steamer Cambria, was shifted last week on the trip down to Ashtabula to the whaleback steamer James B. Neilson. George Barth, second engineer on the Sir William Fairbairn, was promoted to his place. Erastus Shephard succeeds Mr. Barth on the Fairbairn.

Capt. Thos. W. Gould, recently appointed assistant U. S. inspector at Cleveland, has been busily engaged the past two weeks inspecting boats at Ashtabula. Capt. Gould is new at the work, but he seems to be taking well with the men aboard the lake steamers. J. D. Hayward works with him on the after end of the boats.

At the last session of congress an act was passed requiring gasoline launches that carry passengers for hire to carry one life preserver for each passenger carried and to require the operators of the boat to take out a license. The law has but recently gone into force and is not generally understood. A number of arrests have taken place under it at Detroit.

Ashtabula's good records as a coal-handling port are being kept up and improved upon. The steamer Samuel Mitchell, Capt. W. Hagan, operated by Capt. W. C. Richardson, made the run over from Cleveland Thursday night in four and a half hours, and started loading at the Hanna coal dump Friday morning. She took on 3,000 tons by noon and was ready to go with all hatches trimmed.

The steamer Christopher, commanded by Capt. Wm. E. Wright, smashed all her coal-carrying records on her last trip up from Lorain to Superior by taking on 6,651 tons. She cleared from Lorain, July 18, at night, arrived at Ashtabula some time after midnight, July 29, with a cargo of ore. Gordon E. Low and Edward F. Dixon are first and second mates on the Christopher, while Scott Pratt and Neil McDougall are her chief and second engineers.

A semaphore is now in operation at the Sault locks to inform approaching vessels as to whether or not the valves letting water into the locks are open or closed. The opening of the valves causes the swift current in the canal above the locks, making it difficult to handle the vessel. When the valves are opened the arms of the semaphore will be horizontal; when they are closed the arms will be vertical. The semaphore is located at the lookout station on the northwest pier.

The Lake Shore railway has chartered the steamer Alva Chisholm Jr. and consort David Moran to transport limestone from Kelley island to Ashtabula for filling in the new lake front improvement. About 300 ft. of crib foundation at Ashtabula is in place. A portion has been sublet to the Lake Erie Dredge Co. at Buffalo. The contract for building the new east breakwater has been let to the Gillen Contracting Co.

The following changes have taken place in the personnel of the fleet of the Pittsburg Steamship Co.: Capt. A. C. Chapman transferred from steamer Malietoa to steamer Norman B. Ream; Capt. R. F. Humble transferred from steamer Mariposa to steamer Malietoa; Capt. C. D. Secord transferred from steamer A. B. Wolvin to steamer Mariposa; Capt. A. E. Bartel promoted from first mate of Morgan to command of steamer A. B. Wolvin; Capt. H. T. Kelly transferred from barge Holley to first mate steamer Morgan; Capt. Frank Hebner appointed master barge Holley.

Capt. W. A. Black was appointed master of the steamer Republic.

Although it has been commonly believed the steamer B. F. Jones is a

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sister ship to the Michigan, it now appears the former is two feet longer than the latter. For this reason the Jones is the longest ship which ever went up through the draw into the harbor at Ashtabula. The Jones got under way April 27, and came into Ashtabula, July 31, on her tenth trip. Two trips back, she brought in 10,121 tons of ore. Capt. C. M. Ennes commands her.

Capt. George Robarge, commodore of the Hawgood fleet and master of the Harvey D. Goulder, has been in the Hawgood employ for thirty years.

Mr. C. F. Barron, chief engineer of the remodeled passenger steamer Huron (formerly the Darius Cole) began his career aboard ship in 1856 on the steamer Huron running in the Ward line from Detroit to Saginaw. He is likely to end his sailing experience on a boat of the same name, as he has been sailing steadily for fifty years. Capt. Barron was one of the first men to join the Marine Engineers' Beneficial Association. He has been a member since 1863.

It is unusual to have iron ore go up the lakes, yet that spectacle might have been witnessed on Lake Erie last week when the steamers Gilchrist, Steel King and Venus carried ore from Buffalo to Cleveland. The Buffalo & Susquehanna Iron Co. had too much ore of a certain grade and sold it to the Cleveland Furnace Co.

The steel steamer Saturn, in coming down the lakes last week collided with the wreck of the tug W. B. Castle in the Detroit river. That the Saturn was hurt more seriously than was thought was proved by the fact that she settled on the bottom in the Blackwell canal at Buffalo. Her position was such as to block the entrance to the canal for larger boats. She was immediately lightered by the lighter Olga, of the Great Lakes Towing Co.'s fleet, and was then taken to the West Shore dock to unload.

Nearly all the boats on the lakes can claim some unique distinction, but the steamer Cambria has an unusual claim in this regard. She has been commanded thus far by four different captains. Capt. A. P. Chambers, who now sails the steamer J. Pierpont Morgan, was master of her; Capt. Frank Rice, who is now looking after the Crescent City, also acted as her master, and Capt. Thomas Gould, now assistant inspector at Cleveland, commanded her. Each of the three made about one trip when Capt. Geo. W. Ames was promoted from the line to take her. Capt. Ames has Merton G. Allen and George Coffey as his first and second mates. George Barth and John Mraz are her chief and second engineers. The Cambria recently made a seven-day trip to Escanaba loaded both ways. She knocks off thirteen and a half miles and makes the J. Pierpont Morgan travel her wake.

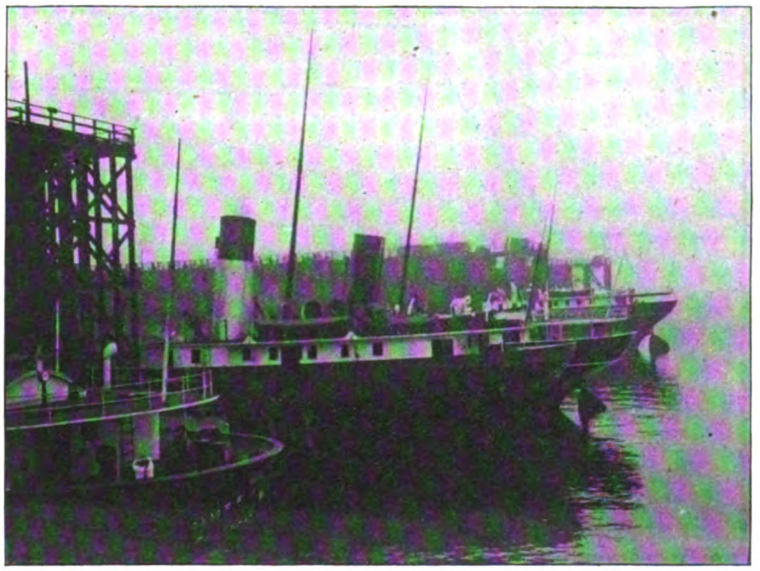
The steamer L. C. Smith in making the turn at Sailors' Encampment last week struck on the starboard side. She was run on the bank of the west side of the river to prevent sinking. Later 1,000 tons of ore were lightered from her.

Capt. Harris W. Baker, of Detroit, has been given a contract to raise the steamer C. W. Elphicke which sank on the east arm of the Cleveland breakwater. Capt. Baker is now lightering the Elphicke's coal cargo upon the schooner Magnetic. As soon as that is completed she will be patched up and pumped out.

The steamer Samuel Mather was launched from the Wyandotte yard of the American Ship Building Co. on Saturday last and was named by Miss Virginia Brush, of Detroit. The Mather is building for Pickands, Mather & Co., of Cleveland, and will be operated by the Mesaba Steamship Co. Her dimensions are 550 ft. over all, 530 ft. keel, 60 ft. beam and 31 ft. deep. The launching party was small. The owners were represented by Capt. George Mallory, shore captain of the Pickands, Mather fleet and Alonzo Arnold, chief engineer. The ship building company was represented by Mr. Frank Jeffrey, general superintendent of the Detroit Ship Building Co.

According to her master, Capt. George Robarge, there is no ship on the lakes as graceful and powerful as the steamer Harvey D. Goulder, of the Hawgood fleet. That he is not alone in this opinion is evident from the expression of other shippers. Capt. Robarge says that the Harvey D. has passed everything up and down, even to the Harry Coulby. But he admits that every time his ship slides alongside the Coulby, he shivers at the thought of a collision between them. The Goulder has now made six down trips, carrying 9,900 tons on a normal draught and running at the rate of twelve miles an hour. She left Duluth, July 24, at night, and reached Ashtabula early Saturday morning, July 28. The new ship brought a party of Harvey D. Goulder's friends around the lakes on the trip, all of whom expressed pleasure at her performance. S. H. Kenworthy and Wm. Hunt are first and second mates on the Goulder. Wm. Stuart is chief engineer.

President Wm. Livingstone, of the Lake Carriers' Association, gave a dinner at the Country Club, Detroit, on Thursday evening last in honor of Mr. Joseph Ripley, who has just resigned the superintendency of the canal at Sault Ste. Marie to supervise the construction of the locks of the Panama canal. Those present at the dinner were: George H. Russel, J. C. Hutchins, Henry M. Campbell, James H. McDonald, W. B. Cady, Edward Molitor, H. P. Davock, Col. G. J. Lydecker, J. D. Sanders, W. A. Livingstone, C. Y. Dixon, Homer Warren, Detroit; Prof. Gardiner Williams, Ann Arbor, Mich.; Prof. J. B. Davis, Ann Arbor, Mich.; Prof. F. A. Barbour, Ypsilanti, Mich.; Mr. George A. Marr, Detroit; Commander Thomas H. Fox and Admiral George C. Reiter.



A REMARKABLE PICTURE.

Photo taken from the steamer Hebard at the Missabe dock in Duluth. It is remarkable in that four boats are loading at the same time and all projecting beyond the end of the dock. The steamers are James B. Wood, William E. Corey, James Gayley and Loftus Cuddy.

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LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION.

BY ROBERT CURR.

Last month a vessel, the J. Q. Riddle, was launched at Lorain by the American Ship Building Co., which was built and launched in forty-five working days. This vessel is one of the latest and up-to-date freight carriers for lake service. She is 552 ft. total length, 532 ft. on the keel, 56 ft. wide and 31 ft. deep. The average output of the punch shop for each day was 80 tons of 2,000 lbs. The following article will show the lake methods of doing this work which may be interesting to those connected with ship building in this country:

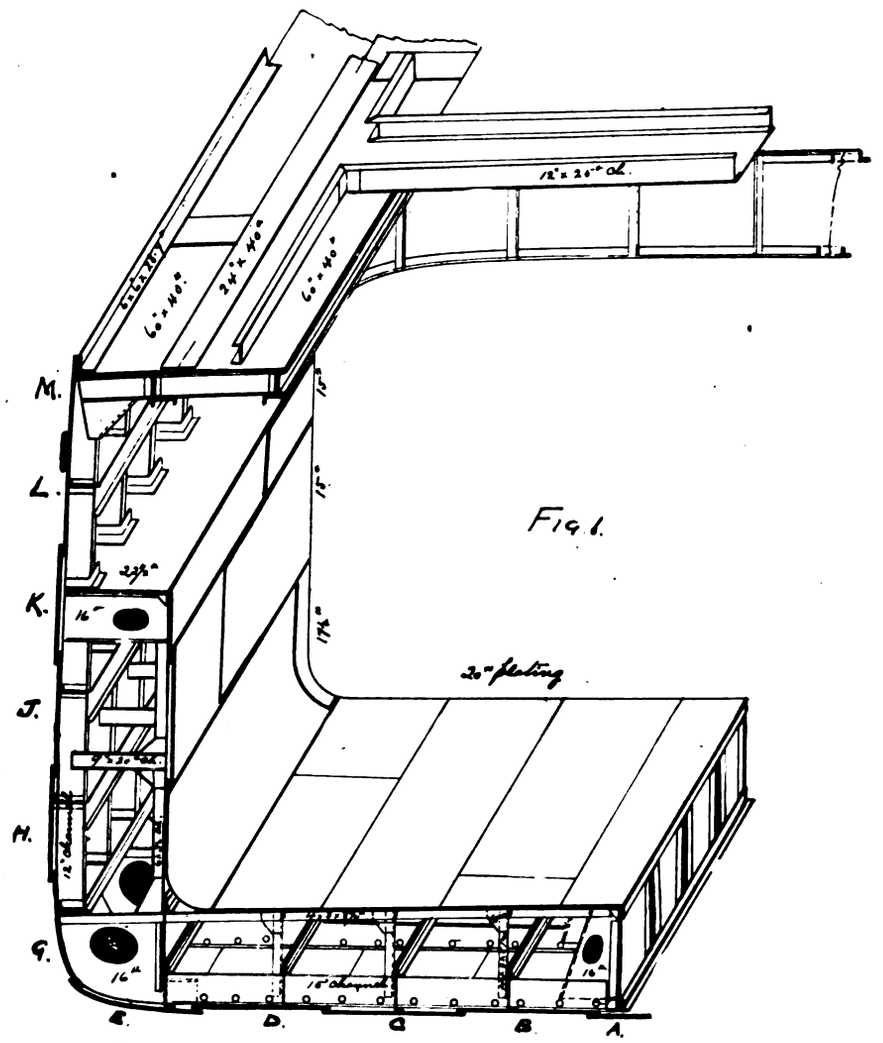

Fig. 1.

Laying off on the mold loft floor is similar in process on the lakes as anywhere else and as there are several works on laying off which can be secured through the MARINE REVIEW, I shall not say much about the same, only what is necessary in describing the process of laying out the work for the punch shop. I may say here that all the material is ordered from the plans in the office of the American Ship Building Co. and the material is all in the ship yard before the plans are furnished. This gives the loftsman more work for the working in of the material depends upon him. This can only be appreciated and understood by those who have had experience in laying off and have had to deal with the material when ordered from the office. This refers particularly to the shell plating. The American Ship Building Co. has an easy and economical method of handling the material coming into the yard. Traveling cranes over the machinery in the punch shop extend to the railroad track where the cars arrive. The material is taken from the cars and piled on edge without very many men being needed. The plates are marked on the edge so that when the marker desires a certain plate he can see the marks on the plate edges without having to turn same over.

In Scotland the plates and shapes are taken from the cars and piled up so that the marker can lay off his work suitable to the system of doing the work there. This work is done, as a rule, on piece work, the men getting 25 cents per ton for taking the material from the cars and laying it out in proper order so that the platers can get the plates or shapes they require first. The vessels are built the same way all the time so that the man in charge of the material knows just what plate will be used first. The clerk in charge is usually a plater and is acquainted with the routine in doing work. The material when laid out is left to the platers who take it to the punch shop and put it through the processes until it is in place on the ship. Ship yards which do not have cranes for handling the stock material, lay the plates on top of each other, on their flat, so that all plates of the same size are put together and the marker puts a wedge under the plate with the use of a pinch bar, raising the plate just enough to get the clip on the template. The plate is marked without the use of helpers until the punch squad removes the plate to the punch. The same method is practiced until all the plates are marked in the pile.

Almost without exception in this country, the marker has the plate or angle put up for him on benches and all he has to do is to clean the dust off the plate and mark same. The overhead crane in the American Ship Building Co.'s shop facilitates this work and as the sorting out the material and taking same into the punch shop to be maked costs less than half of the Scotch laying out, there is no use of discussing same. The American methods in this particular section are in favor of the home system.

The loftsman receives the offsets similar to other ship yards here and abroad, with the exception that the material is all ordered and care must be taken to see that it fits on the vessel which can always be detected before the mold is made. After the midship section is determined on the floor, a mold is made for the frame bender, which allows him to have a start ahead of the loftsman of about two weeks. Before the vessel is finished, the frame bending as a rule is not very much ahead.

Fig. 1 shows a midship section of the vessel under discussion. The lake method is to make a mold for each piece, viz., channel frame, channel floor, tank top angle, tank side channel, center keelson bracket, bilge bracket, girder bars and brackets, clips, tank side channel brace, top plate on tank side, center keelson vertical angles, beams, beam brackets and beam clips. The above is what composes the main frame.

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The holes are all drilled in the molds for the component parts which constitute the frame.

Shell holes have to be taken care of on the frame flange to the shell, also on the floor. Molds are made for this purpose which will be explained when that section is laid out.

Fig. 2 is the plan of the helt frame spaced 12 ft. apart. The process is similar to the main frame, molds being made for the plates and angles.

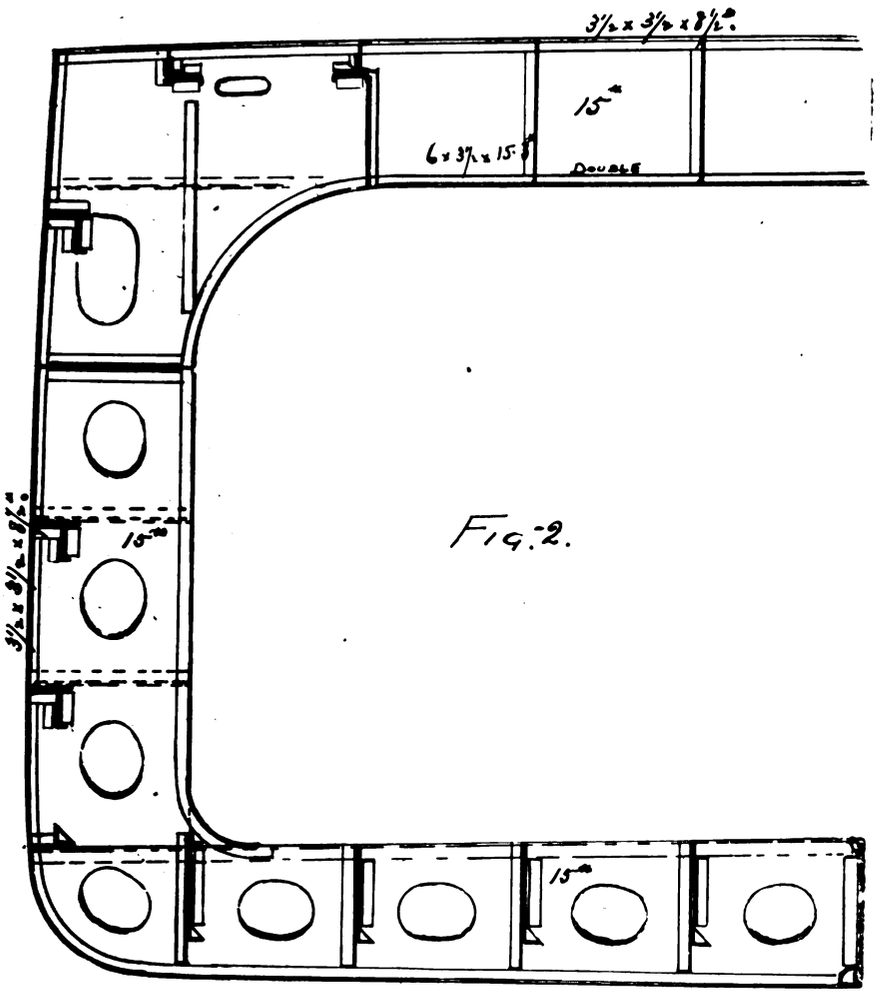

Fig. 2.

Eighty-five per cent of the framing is laid off with these molds, then a mold is made for each frame forward and aft of midships.

A number of frames and plates are worked from the full molds by drawing same in at the bilge below or extending in the same way (where the sheer increases) above bilge.

In Scotland the frame and its parts are laid down on a platform, what is termed the Scrieve board. The same care is not taken there in getting out the small pieces, such as stringer clips, girder stiffeners and beam knees which are put in after the vessel is ribbanded, which will be explained later.

Figs. 1 and 2 show just how the pieces would be laid out on the board and all the pieces marked in and punched. Fig. 1 the pieces would be laid down as shown, the main frame, being placed with the web up and the floor on top which would allow all the pieces to be laid down on the board. The pieces on top would be punched and the under pieces marked for same. The web frame, Fig. 2, would be easier to lay down on a flat surface because the plates would be put down as shown on plan, the excessive material be sheared off to the angles which are punched and laid on the plates. The Scrieve board is quite a factor in the British method of framing ships. It is composed of a pipe platform planed smooth and painted black with lamp black. The lines of the body plan are transferred from the mold loft and scratched in on this platform so that the various lines may not be rubbed out by pulling the steel plates and shapes across them.

The Scrieve board practically begins the construction of steel ships in Scotland.

After the Scrieve board is finished and all the lines representing Figs. 1 and 2 are scratched in and painted with different colors of paint, the framing squad takes possession of the board. Long strips of pine 1 in. by ¼ in. are bent around the frame lines and the plate edges marked on same or any parts which may be doubtful to punch before the frame angle is bent. The frame angle will stretch in bending so that is provided for when the batten is laid around the frame line on the Scrieve board. The lower part of the batten is drawn over the center line the amount necessary. This batten is laid on the frame angle and all the shell laps marked on which are left blank until the plate lines are faired up on the ship. The holes between the plate laps on the frame angle are marked, also the holes for the miner flange, care to be taken that the holes will not come foul of stringers or opposite each other.

In order to get the shape of the frame angles, or channels, a set is made of iron 1½ in. by ⅜ in. and bent to the curve on the Scrieve board. The set is always made to the inside edge of the frame and fastened down to the bending slab and the hot angle wound around same, which makes fairer work and does not leave pin marks on the inside of the flange. When channels have to be bent heavy pieces of set iron three inches square are bent to the bilge shape and the channel wound around same thus making fairer work than simply depending upon the pins and rings cast for that purpose. Rivet holes are very often not punched on the frame angle at the turn of the bilge because the turning of same elongates the hole, a ¾-in. hole before the frame is bent will change to one inch by ½ in. when bent or something of that shape.

The channel frame shown on Fig. No. 1 would not be punched below the line of tank top. A greater number of frame angles can be punched straight than when set to curve of frame, but as the frame has to be taken back to the punch machine for holes which would be impossible to get fair, the saving in punching before bending does not seem to be much.

The lake system must have all the frames bent and corrected before the same is marked from the mold.

Correcting the frame is another item to be considered. In frame bending there is a certain amount of spring when the frame becomes cool. If a man figures on a frame bar losing say one and one-half times the flange in set when the bar cools off, of course the heat must be the same to retain the same spring. If the frame bar does not have the same heat as figured on the one and one-half times the flange, then the losing of the curvature will be greater. An allowance is made for this by giving the frame bar more set when hot, so that when it cools off the angle will be right to the set. It is rare that the frame bar is

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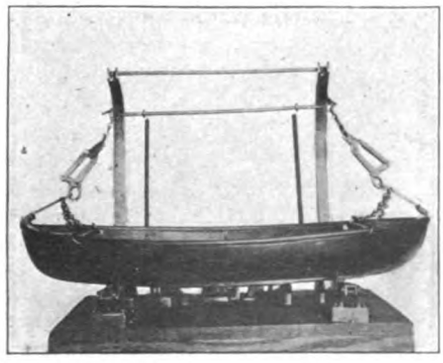
correct when cool after being bent. This is got over by hammering up the angle until it is correct. There is an objection to the hammer being used because it leaves hammer marks on the edge of the frame angles.

When angle frames are used on the lakes, the loss of set is found and the allowance made but the correcting is done at the cold press, which leaves no marks on the edge of frames.

To take the material from the stock yard, set, mark, punch and erect same on skids ready for bolting up, would cost in Scotland for Fig. 1, $40 and for Fig. 2, the web frame, $70. The first impression would be that the mold system would cost more than the Scotch, but it costs only about one-third by the use of molds. It is not likely that this type of vessel would be built for ocean traffic, but all the same any kind of construction can be done cheaper and more uniformly when the vessel is laid off from the mold loft. All the advantages of this system will be seen in these articles.

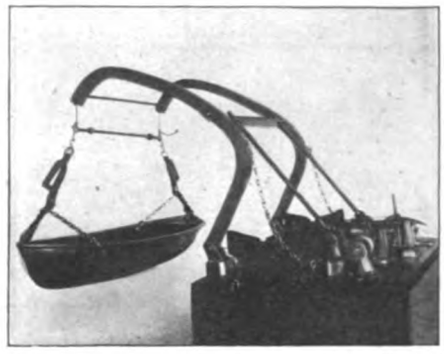
IMPROVED SHIP'S DAVIT.

The Groff-Selee Davit Co., Ashtabula, O., has just put on the market a ship's davit which has many elements



FRONT VIEW SHOWING BOAT IN THE SADDLE.

of superiority in launching vessels from a boat's deck over the ordinary devices. The design is very clearly conveyed in the accompanying photographs. This device is likely to save its cost in steamer repairs annually. One of the first things to be damaged in brushing along a wharf or in crowded waters, such as rivers in lake ports, is the old-style davit which sets out to the rail. The Groff-Selee davit is located back from the rail and cannot possibly be injured in that manner. It will be seen that there is not a piece of rope or tackle used about it. Anyone who is familiar with the fouling of tackle at all times and its freezing during winter will appreciate how many elements of risk are avoided by this device. In the old way there is always danger that the boat may not be lowered on an even keel and therefore spill her passengers by one end going faster than the other. By this davit both ends of the boat are always even in raising or lowering and moreover can readily be operated by one man. The full complement of passengers can be put in the boat as she sits in the saddle. There is little in the device to get out of order as it consists of pivoted crane arms which extend under and about the boat and swing it outboard from whence it is lowered into the water by means of a threaded shaft operated by a hand winch. The



SIDE VIEW SHOWING CRANE ARMS EXTENDED READY FOR LOWERING BOAT.

boat is suspended from the crane arms by lines, the hooks automatically detaching themselves when the boat is supported from the underside, as by water. The device is very simple and substantial and should prove eminently practical. The officers of the company are: C. J. Starkey, president; M. H. Joyce, vice president; T. A. Cheney, treasurer and F. S. Bennett, secretary.

QUESTIONS FOR WHEELSMEN AND WATCHMEN.—NO. 4.

Give all shoals and principal land marks passed on either hand.

Note.—In all cases where the course is not printed on the chart take it off according to directions, and give both its true and mean correct magnetic directions. When the course is printed merely give its (mean) correct magnetic direction, as already explained.

42. Give course and distance from Conneaut to Bar Pt. via north passage.

43. Give course and distance from Ashtabula to Bar Pt. via north passage.

44. Give course and distance from Erie to two miles N W Cleveland breakwater light.

45. Give course and distance from Conneaut to two miles N W Cleveland breakwater light.

46. Give course and distance from Ashtabula to two miles N W Cleveland breakwater light.

47. Give course and distance from two miles N W Cleveland breakwater light to entrance buoy Sandusky channel.

48. How would you navigate a ship from Sandusky entrance buoy to B. & O. R. R. dock?

49. Give course and distance from two miles N W Cleveland breakwater light to entrance Toledo straight channel light via south passage.

50. How would you navigate a ship from Toledo straight channel light to Hocking Valley R. R. coal dock?

51. Give course and distance from two miles N W Cleveland breakwater light to Bar Pt. via south passage.

QUESTIONS FOR MASTERS AND MATES.—NO. 3.

1. What two kinds of magnetism are there?

2. Which kind of magnetic poles attract one another?

3. What is repulsion in magnetism? Give an example of it.

4. Why is it that the north end of the compass needle directs itself toward north?

5. What is the north pole of the earth's magnetism and where is it situated?

6. Define the true or geographical north pole of the earth.

7. Where does the direction north begin?

8. Are there places on the earth's surface where the magnetic needle actually points to the true north pole of the earth? Does the needle at the same time point to the north magnetic pole?

9. On which of the great lakes do we have easterly variation, and on which do we have westerly variation?

10. What is the true bearing of the true north pole for an observer stationed at Cleveland? What would be the true bearing of the north magnetic pole for the same observer? What are these two directions called?

11. Why is it that variation is named easterly and westerly?

12. Which way do you allow easterly variation in turning a true course into a correct magnetic course?

13. Which end of the compass needle has the greatest amount of magnetism, the north or south end? Why?

14. What is a 4-point bearing? Give an example and explain its use.

15. In a right-angled triangle what is the longest side called?

The Acme Steamship Co. gave a contract to the American Ship Building Co. last week for a freighter to be a duplicate of the steamer James C. Wallace. She will therefore be 552 ft. over all, 532 ft. keel, 56 feet beam and 30 ft. deep. She will have quadruple-expansion engines with Babcock & Wilcox boilers.

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WRECKING THE LAFAYETTE.

While those who did not pass through its perils will never realize to the fullest extent the fury of last November's storm, to view the wreck of the Lafayette where she lies eight miles northeast of Two Harbors is to see ample evidence of its tremendous violence. Scarcely anything could be more striking or suggestive than the contrast between the magnificent north shore which seems none the worse for its buffeting and the steel leviathan that lies broken in three parts, twisted and torn to veritable shreds on its rocks. The Lafayette struck broadside on a nose of rock, the prow breaking away and turning over with the bottom high on the rocks and the spar extending out into the water. The amidship section from hatches No. 5 to 12 is nothing but a mass of bent and broken steel. Steel plates and I beams alike were sheared off and knotted as though made of wire. In fact the sides and deck were sheared off cleanly from the bottom as may be distinctly seen down through the clear water. One can row in and out through the hatchways and look down into the water, a mass of steel strewn over the bottom, can see where the deck engines have broken loose and rolled off into deeper water, trace the outlines of the pilot house and the crow's nest on the foremast and catch the glint of the brass railings about the upper deck. The deck engines and fixtures of the fore part of the boat will be saved but the real salvage operations are limited to the stern and in all it is estimated that at least $60,000 worth of property can be saved.

The stern of the Lafayette was broken off cleanly through hatch No. 12 and lifted into a small cove 30 ft. away from the part from which it was torn and now lies heading straight out into the lake, listed about thirty degrees to port, with the starboard side close up to the nose of rock and the stern within twenty-five feet of shore. A large hole was punched in the after peak tank through which one can look down into the water from within the boat. The bottom under the run of the boat has been punctured in several places letting water into the well and the wreck now stands so that the water is about on a level with the top of the "A" frames of the engines. The engines and the steering and other machinery aft are all in good condition for last fall all the pipes were drained and protection provided for the exposed parts against weathering. The engines seem to have suffered little from the shock and could soon be made ready for active service again.

The plan of Capt. Smith is to seal up the leaks in the well and pump the water out so that the anchor bolts of the engine may be gotten at and loosened, lift the engine out, relieving the stern of that weight and then floating the hull build a bull head across the broken section, preparatory to towing the whole thing into Duluth. The engines might possibly be loosened by divers but that method seemed to be the more difficult, clumsy and tedious in the present instance. Already ninety bags of cement have been used in patching holes that have been found but there still remain some leaks which will have to be discovered by pumping as fast as possible and following the currents of water in the hold Handfuls of hemp strands are scattered outside of the leaking compartment and the suction of the water draws them into the leak plugging it up and indicating its location.

Capt. Smith and his crew of wreckers have now been at Encampment Island six weeks and most of that time has been spent in preparatory work. A camping ground has been cleared and tents pitched for the party to which a path from the wreck had to be cut through the woods for half a mile. A bridge had to be built from the wreck to the shore, boiler and pump set up and the framework of the boat cut away above the engines to permit free access. A great deal of diving work has been necessary. The manhole down into the after peak tank was too small to admit the diver and a hole had to be cut in the floor. No attempt will be made to patch the bottom at this point but when the hull is ready for raising the hole that has been cut in the steel flooring will be sealed with a water tight joint and the water allowed to fill in that section. The work is made more difficult because of the pitch of the deck and facilities for getting steam have not been of the best. The steamer A. B. Wolvin has had additional steam pipes connected up to her boilers so that she can supply steam at any point along her side. Between trips the Wolvin has been furnishing steam for the pumps on the wreck and it is something of a novelty to see this big craft close alongside the wreck, backed up within twenty feet of shore with sixteen feet of water under her stern. An impression has gone out that the Wolvin has been extensively fitted out as a wrecker but beyond the steam piping nothing has been done to her as yet. A boom however, is to be placed on her foremast and because her build, provided as she is with a between decks, lends itself advantageously to wrecking purposes, the boat will be used, as emergency requires, in that capacity though continuing to carry ore.

The rotary pump that had been doing service up to last week was found insufficient and leaving on the tug Mariel for Duluth thirty-four miles away on Thursday afternoon, Capt. Smith obtained a large turbine pump and engine, returned, transferred the pump and engine from the tug to the wreck by means of shear legs, connected up a steam line and was pumping water by two-thirty Friday afternoon, something of a record considering the difficulties of handling heavy work in those quarters and the scramble for fittings some of which had to be taken from the Lafayette. For lifting out the engines two trees to be used as shear legs, were picked out last fall from the woods close by and just last week were cut down and stripped by the crew, brought aboard and mounted in place the men working till midnight to get the thirty-foot timbers erected. While no definite calculation can be made it is thought that six weeks will see the wreck ready for floating.

A meeting will be held at the office of Col. Charles E. L. B. Davis, government engineer at Detroit, on Monday next to discuss plans for the improvement of Duluth harbor. A committee of government engineers visited the harbor last week and were inclined to recommend the breakwater plan. Leading shipping interests, however, do not think that the breakwater is altogether desirable, but prefer that a channel should be cut from Minnesota Point to effect an independent entrance both to Duluth and Superior harbors. Col. Davis will hear them upon this subject on Monday.

The standardization trial of the battleship Nebraska, held off Vashon island, developed the fact that the vessel will have no trouble in making the speed of nineteen knots required by the contract. Thirteen runs were made over the measured mile course and the highest speed developed was 19.51 knots an hour. The average speed for five of the fastest runs was 19.237 knots. The main engines made 125.35 revolutions per minute as against 119.85 revolutions required for a ship of 19 knots. Those aboard the vessel during the trial declare that she performed in a highly satisfactory manner.

Wm. H. Lucas died at Atlantic City on July 1. He was a member of the firm of John Lucas & Co., of New York.

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LIABILITY OF THE ENGINEER.

FROM THE *Marine Engineer*, LONDON.

In considering the position of the engineer at sea, it should not be forgotten that he, like the deck officer, runs the risk of having his certificate suspended or taken from him. True, this may be his own fault, but there are cases where the fault is manifest to the court and is by no means necessarily apparent to the man on the spot and at the time. There has recently been held at Whitby a somewhat unusual Board of Trade inquiry. It concerned the abandonment of the steamship City of Gloucester on her voyage from Huelva to New York with a cargo of pyrites. The ship was not overladen, and amongst the weights which she carried on sailing was 130 tons of bunker coal. This was to be augmented at St. Michael's, where the ship was to coal. She was six days on the passage to the coaling port, and, traveling at the rate of 6½ knots, pulled her coal supply down to 35 tons. That is to say, on this part of her voyage she burnt just under 16 tons a day. At St. Michael's a supply of 210 tons was taken on board, or at least believed to be so taken. At all events that was the quantity paid for. She thus had apparently 245 tons aboard. Judging by the experience of the earlier part of the trip, and assuming that the coal was of similar quality, she should now have had about fifteen days' fuel. All went on in the usual course till the ship had been eleven days at sea; she was then some 200 miles from Bermuda, and 480 miles from New York. Then the chief engineer reported to the master that he had but three and a half days' coal left in his bunkers. The calculation now was that the ship had burnt 17½ tons a day instead of, as assumed, under 15 tons. But we see that she had averaged a knot better than she had done previous to her call at the Azores. That knot would mean an extra distance of 24 miles a day steamed, which in eleven days would be 264 miles, or, say, a day and a half's steaming. That would mean at the master's own estimate 22½ tons. On the other hand the extra consumption of 2½ tons a day for eleven days would only mean 27½ tons, so that the whole difference works out at a matter of but five tons when all is said and done. When the ship coaled at St. Michael's the chief engineer was responsible for the tallying, and the court threw some doubt on the accuracy of his count. At all events they agreed that whether it was the full 210 tons that the ship got or not, it was insufficient. We have seen that it obviously was, but the point for us is as to how far the engineer was responsible. He must have estimated the amount remaining on board when the ship coaled. He must have reported the amount he tallied as shipped. When these things were known by his superior, the master, his responsibility in regard to them surely ceased. Again, when he reported the deficiency the ship ought at once, in the view of the court, to have been put for Bermuda. This was not done. An attempt was made to reach New York by burning woodwork to supplement the coal. Bad weather came on, the engines lost steam, the ship became unmanageable, fell into the trough of the sea, and was pounded to death, the crew escaping to a Norwegian sailing vessel. In the opinion of the court the loss of the City of Gloucester was due to the deficiency of her coal. They held that it was wrong when the report was made that so little coal remained, to attempt to go on to New York, especially as no attempt seems to have been made to economize fuel by running more slowly. Now, we venture to think that as the engineer disclosed all the facts to the master, and as the decisions as to continuing for New York, and as to the maintenance of full speed were entirely in the discretion of the captain, there is some hardship upon the engineer in his suspension. The only real ground upon which fault could be found with him would seem to be that he did not discover the shortage of coal earlier than he did. But the figures we have mentioned would surely seem to show that the shortage was a small one, and therefore not very remarkable. The real reason of the deficiency was the shipping of too small a supply at St. Michael's. The fatal result might have been averted by putting about for Bermuda. Where does the chief engineer's responsibility for these things come in? If he was not responsible for them he has had rather stern justice meted out to him, and we would suggest that the Institute of Marine Engineers might well examine the facts of the case with a view to the chances of an appeal, if they are advised to attempt one.

ENGINEERING ITEMS FROM BRITAIN.

BRITISH ADMIRALTY DECIDES FOR OIL FUEL.

The decision of the British to fit torpedo boats and small craft to burn liquid fuel for steam raising is an indication that the naval authorities are prepared to adopt any course when it can be proved without doubt to be superior to that hitherto followed. For years liquid fuel has been under "trial" in the British navy, and provision has been made for its use as an emergency agent in many cases, but owing to the proofs of its superior steam-raising powers during the maneuvers, the small craft under the white ensign will in future be confined to the burning of oil as fuel, coal being eliminated from the equipment of the craft. The actual experience of the ships engaged in the maneuvers provided with oil, and facilities for using it in the water-tube boilers showed not only a very material superiority in speed, but was a wonderful relief to the "black squad" in the stokeholds, who had been very heavily worked in maintaining a high speed under coal consumption. The result is a victory for the advocates of liquid fuel.

Engineering, London, advocates the standardization of naval machinery. The arguments brought forward are convincing, and show that by adopting the system of standardization so widely carried out in the United States in so many directions, a great benefit would result. Taking, say, three war vessels of one type with machinery made to one standard, it is clear that in the event of war if one was disabled in the hull and another in the machinery, the damaged parts of the machinery could be replaced immediately by taking them out of the crippled ships. By manipulation, therefore, which would take but a very short time, one ship only would be placed hors de combat instead of two.

Mr. William H. Hunter, the chief engineer of the Manchester ship canal, expresses the opinion that a lock type of canal at Panama will bring about disaster. He bases his principal objection to the lock system on the liability to damage through unavoidable accidents, and points to the record on the Manchester ship canal, where, since its opening 12 years ago, dock gates have been five times wrecked by vessels.

The growing popularity of the turbine for marine propulsion and shore work keeps manufacturers increasingly busy in Britain. It is now reported that Messrs. C. A. Parsons & Co., of Newcastle-on-Tyne, have secured contracts for a 316-K. W. exhaust steam turbine generator for Messrs. John Brown & Co., Ltd., Sheffield, a 3,500-K. W. turbine alternator for the Newcastle-on-Tyne Electric Supply Co., a 200-K. W. turbine alternator for Messrs. Archibald Russell & Co., Ltd., and a 400-K. W. turbine generator for the Consett Iron Co., as well as a 200-K. W. turbo alternator for the far east.

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EXPERIMENTAL TANKS IN BRITAIN.

We are indebted to Messrs. John Brown & Co., of Clydebank ship building yard, Scotland, for the five photographs which here illustrate the ship model experimental tank erected in their works, and which proved of such value to them in investigating and obtaining the necessary information for designing the mammoth Cunard vessel, Lusitania, which they have recently launched. The acquisition of this tank has been a decided advantage to them in solving the best form and proportions for any required vessel, and has also aided them much in guiding the choice of the most suitable propellers for each ship. At the present time when the steam turbine is replacing the reciprocating engine, it is especially useful in finding the effective horsepower from model experiments, rather than to have to work entirely from former experiences of indicated horsepower in reciprocating engines. The high number of revolutions necessary for turbine efficiency causes modifications in the design of suitable propellers, so that previous practice has to be departed from. Tank experiments can however, be relied on to supply the necessary information to go upon.

Some interesting particulars relating to this subject were recently compiled by *Engineering*, London, in which it is pointed out that the only two properly equipped experimental tanks in the world belonging to private ship building firms are situated on the Clyde. Of these the first is that put down by Messrs. Denny Bros., at Dumbarton, while the second is that now under notice. The other tank is owned by the Norddeutscher Lloyd, and is situated at Bremerhaven; of the remaining nine existing tanks, six are government basins, the property respectively of Britain, the Netherlands, Italy, France, Russia and the United States of America. Cornell and Michigan universities and the technical high school at Charlottenburg are each equipped with one. At Paris a tank is being constructed for the use of the admiralty and the students of the university, and several others have been proposed in Britain and Japan.

The waterway of the Clydebank tank extends for 445 ft., of which 400 ft. is deep, varying from 9 ft. at the north end to 10 ft. at the south end. This fall of one foot is gradual, and is for the purpose of drainage when emptying. The breadth is uniformly 20 ft. At the north end there are wet and dry docks; of the wet docks, one is for storing models, and the other, placed between the dry docks, is used for loading and trimming purposes. The towing-truck can be run over the central dry dock, and the dynamometer and propeller gears examined from it; the latter must be raised to clear the dock sill. At the south end there is a sloping beach, 25 ft. long, to assist in breaking up the waves formed by the passage of a model through the water. A recess, however, is left up the middle to prevent screws or models being run aground. The basin, which is rectangular in cross-section, is formed of concrete, with expanded metal and puddled clay backing. The building is of brick, and, besides the tank proper provides accommodation for a large drawing office, a tracer's room, and superintendent's office, with the necessary fireproof record-rooms, etc. Adjoining the tank and in communication with it is a complete new department for model makers. These assist in the work of the tank by making cores for the casting of paraffin wax models, and in fairing down the latter when they come from the shaping machine. As it is necessary to keep the temperature of the tank at or about a uniform degree, winter and summer, a complete system of hot water piping

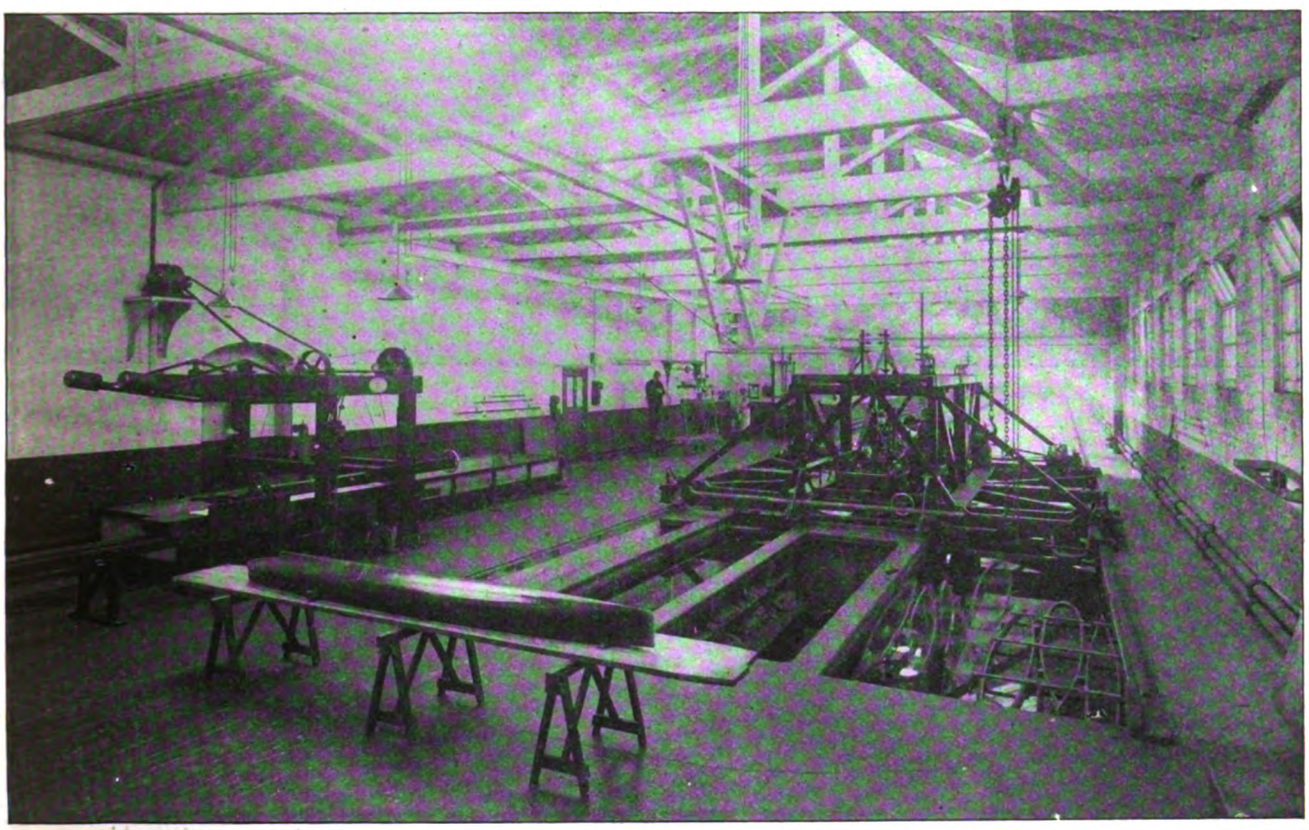

FIG. I.—CLYDEBANK EXPERIMENTAL TANK. LOOKING SOUTHWARDS SHOWING DRY AND WET DOCKS.

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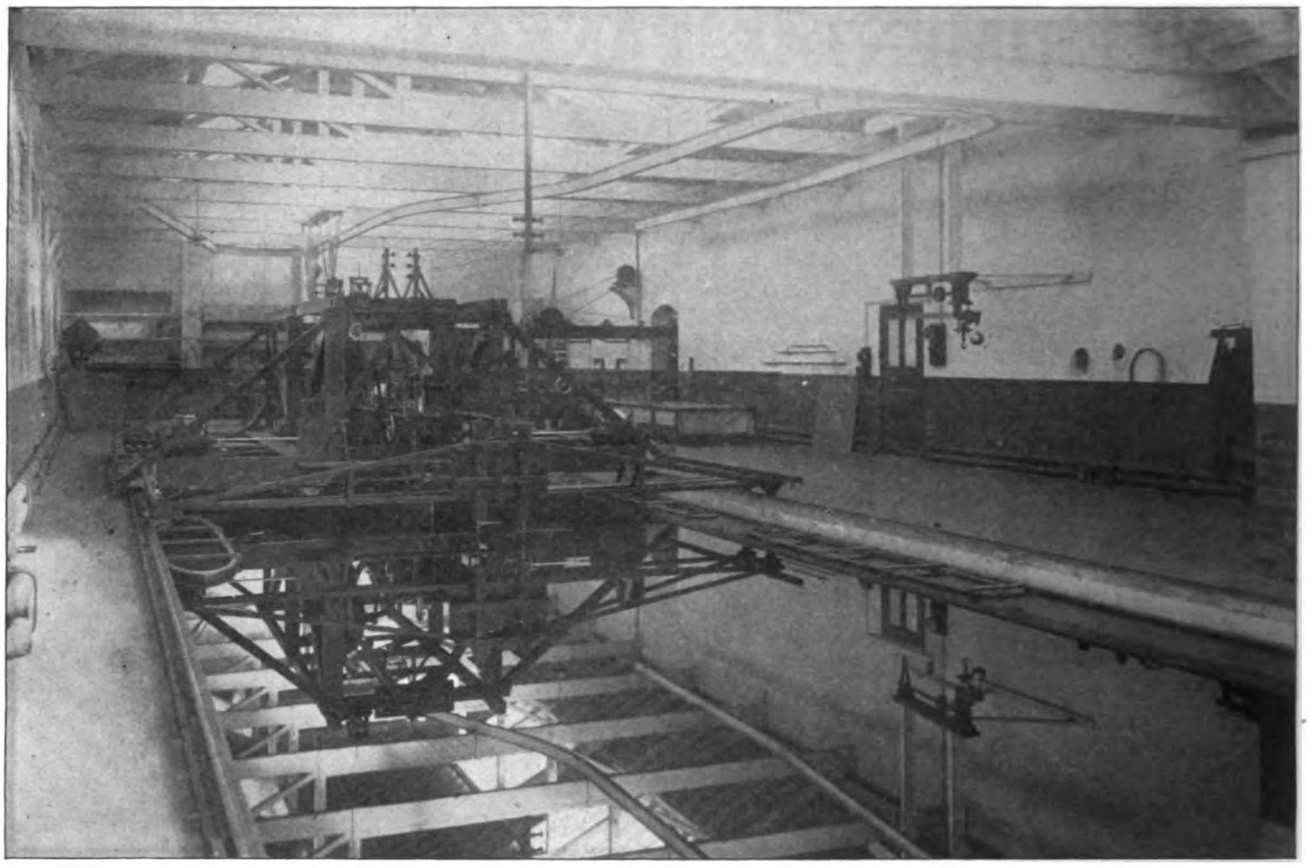

FIG. 2.—CLYDEBANK EXPERIMENTAL TANK. LOOKING NORTHWARDS, SHOWING STARTING POINT IN WATERWAY.

is installed, and the heat is controlled at the calorifiers, of which there are two at the north end, and one at the south end of the building, in rooms for the purpose. The offices and shops are heated on the same system with pipes and radiators.

The models used are generally about 15 ft. long, although exception is made in the case of high speed torpedo boat destroyers, when the length is about 11 ft. The model of the new 760 ft.

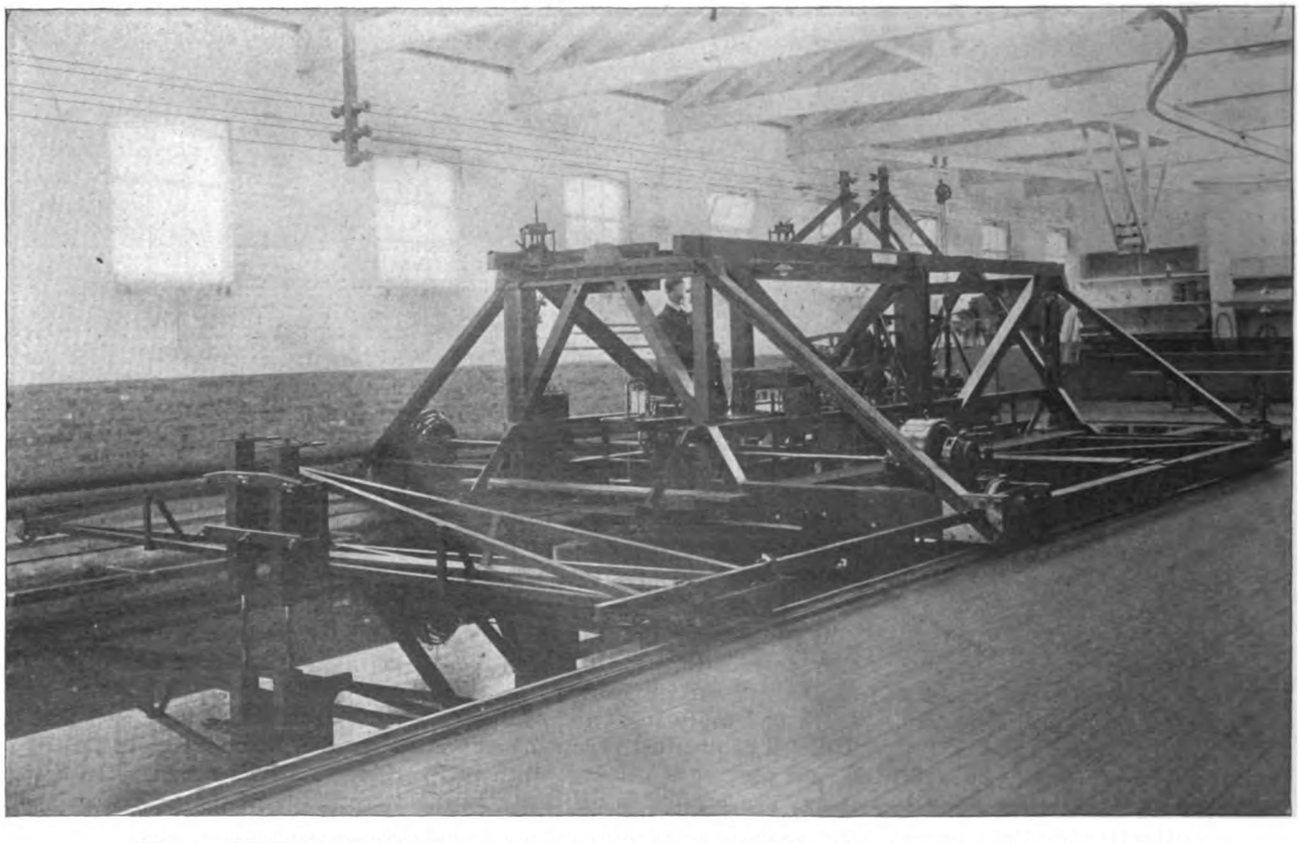

FIG. 3.—CLYDEBANK EXPERIMENTAL TANK. SHIP MODEL TOWING CARRIAGE WITH RECORDING APPARATUS.

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Cunard liner, which is to steam at 25 knots on trial, was made to a scale of 1-48th, being 15.83 ft. in length; the speed of this model corresponding to 25 knots was 365 ft. per minute, or about 3¾ knots, but models are always run over a range of speeds lower and higher than that proportionate to the trial speed of the ship, and they are run at these speeds in three or five conditions of displacement, so that complete information relating to displacement speed and resistance is obtained for each model.

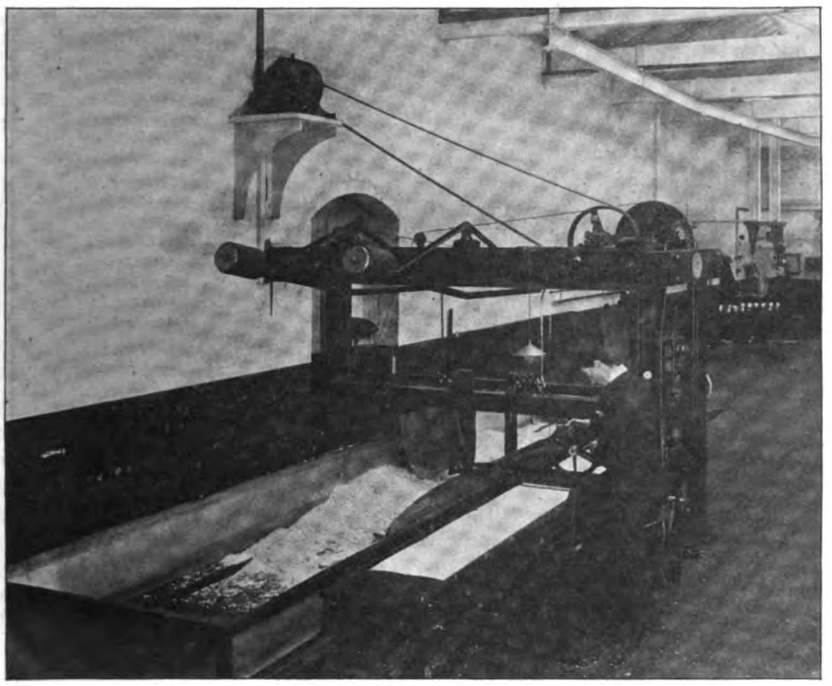

FIG. 4.—MODEL CUTTING MACHINE, EXPERIMENTAL TANK, CLYDEBANK SHIP YARD.

In the views of the north end of the tank, the melting boxes are seen supported on the wall. Paraffin wax with a small addition of beeswax is melted in the upper box and strained into the lower or storage one; from there it is run off through pipes into a mold in the clay, or casting box, the mold being carefully prepared to the shape required for the model, with a margin allowed, and having a core of lath and canvas to regulate the thickness. When the casting has sufficiently set, it is leveled on the top and carried to the cutting or shaping machine shown in our illustrations, by means of lifting gear with a differential pulley, and running on an overhead rail. When a model has been through the cutting machine, it presents an appearance of terraced steps, and is not smooth like the one shown in the illustration. The models are finished by hand to the water-lines cut; these latter are usually about ¾ in. apart on the side and closer at the bilge and on the rise of floor. When finished the model is accurately weighed, as shown in Fig. 5, and is then launched. When about to be tested the model is loaded to the proper draught as measured by needle-point gauges off a defined freeboard line. When not in use, models are submerged to prevent them from changing shape owing to unequal loading. This is, as yet, the only electrically-driven tank carriage in Britain, motive power in the other cases, being supplied by a rope driving from a winding engine. Current is supplied from one of the yard power stations, but as it would be too irregular if applied direct, it is passed through the motor generator at a suitable and regular voltage, and delivered to the tank. The trolley wiring is on the Ward-Leonard system which has the advantage of delivering current at a constant voltage throughout a run down the tank—a very necessary requirement when it is essential to maintain uniformity of speed. Two six-brake horsepower motors drive the carriage, and from shafts connected to the wheel cord leads are taken to rotate the resistance recording drums and trim cylinders on the main truck, and to drive the screw propellers and rotate the record drum on the screw-truck. Automatic cut-offs for the motive power are fitted on the top of the carriage, being operated by fixed strikers on the roof beams, one near each end of the tank. When these strikers engage the triggers, the driving current is cut off and the electrical brakes are put on. The record drums and trim cylinders are so geared as to make one revolution in the length of the tank, at whatever speed the carriage may travel. By using various pulleys provided for the purpose, a wide range is possible in the number of revolutions given to an experimental propeller or propellers for any required speed of model.

The method of measuring the resistance of a model is that used by the late Dr. Fronde, of recording graphically the extension of an accurately-made spiral spring. The extension is magnified twelve times, and each spring is standardized in position before use. A model is shown in the

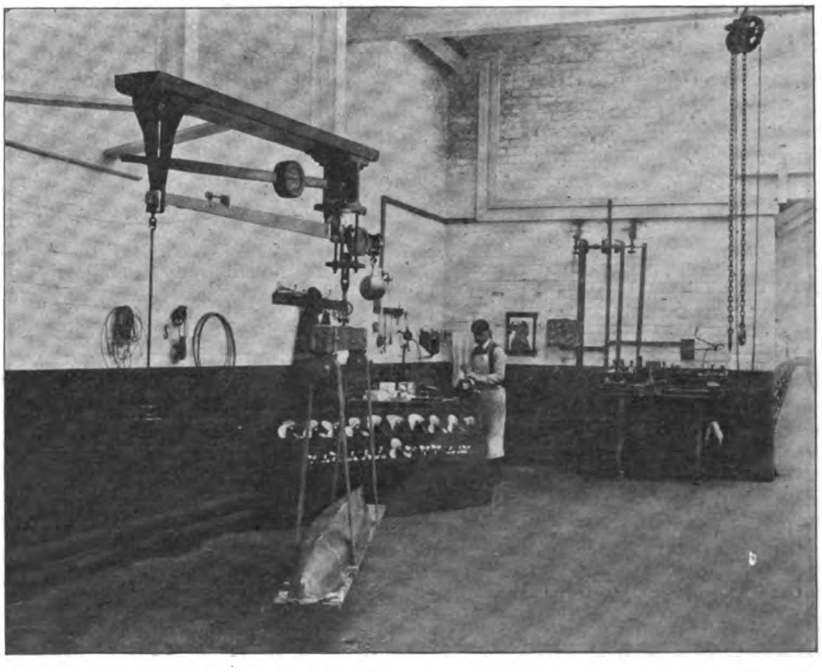

FIG. 5.—MODEL WEIGHING MACHINE AND APPARATUS FOR MAKING PROPELLERS, EXPERIMENTAL TANK, CLYDEBANK.

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illustration No. 3, in place below the truck; at the bow and stern are guides to prevent it "zawing," but not in any way to pull or retard it. The operator holds the model by means of two vertical levers until the truck has attained a uniform speed, when he allows the model to pull on the dynamometer, letting it go gradually. On one side of the tank, from north to south, are "mile-posts" — small contact-makers alongside the rail 25 ft. apart.

On the resistance drum the following are recorded: (1) The resistance in pounds; (2) the distance traversed in multiples of 25 ft.; (3) time in half seconds; (4) a measure of the current in the water as recorded by the revolutions of two log-screws running in advance of the model; (5) a graphic measure of speed from a strophometer, used for detecting any want of uniformity of motion, this is geared directly off the driving shaft. Nos. 2, 3 and 4 are recorded by pins actuated by electro-magnets. From Nos. 2 and 3 speed in feet per minute "over the land" is obtained, and, when corrected for current, speed through the water is got. Then for a given model at known draughts and of known displacements, the resistance in pounds and speeds in feet per minute are obtained.

In special cases the trim is measured while on the run, by graphically recording the change of level at the bow and stern. Then a vertical rod of aluminum is supported on a knife-edge on the boat, and carries a pin at its upper extremity. This pin marks paper on a vertical cylinder, on which is traced a datum line; as the model is run down the tank, this cylinder revolves, and the pin marks the rise or fall of the bow or stern with regard to this datum line. Alterations of trim and draught when running are of great importance in paddle steamers, as are also wave configurations along the vessel's side; these latter can be accurately got from the model experiments by photography, and the proper paddle float immersion given.

On the screw-truck time, distance and revolutions of the screw-propellers are recorded on the rotating drum by the aid of electro-magnets with pen arms attached. "Thrust" and "belt" in pounds are weighed by means of spiral springs, and automatically recorded. Many refinements are introduced to reduce friction such as ball-bearings, etc., and the masses of the gurnard and shafting are balanced by weights about the upper watch springs. Idle "thrust" and "belt," i. e., with the propellers off, are recorded under the same conditions as gross "thrust" and "belt," and the net value of these due to the presence of the propellers ascertained. Friction due to the load of the propellers can also be allowed for. By the aid of this part of the apparatus such problems can be solved as "propeller efficiencies," associated with definite "thrusts," while, in conjunction with the main truck, the following can be ascertained: "Wake factors," "thrust deductions," and "hull efficiencies."

One corner of the tank building is devoted to the making of propellers and one illustration, No. 5, shows a number of propellers that have been used experimentally. A light lathe also shown is found very useful in "tipping up," boring and finishing the bosses of propellers, and in the general work of the department. The results of all model experiments are first plotted in curves of resistance in pounds on a base of speed in feet per minute. Afterwards they are reduced to the constant system introduced by Dr. R. E. Fronde. Tank experiments can only supply values of effective horsepower for given forms; to get the corresponding I. H. P., a propulsive coefficient has to be used. This is purely a matter of judgment, based on previous experience with similar ships and engines, although the introduction of turbines renders a knowledge of the effective horsepower more desirable than the indicated horsepower as used in reciprocating engines. Still it cannot be too strongly enforced that progressive speed trials should be conducted with the greatest care, and the results critically analyzed. Otherwise propulsive coefficients cannot be accurately obtained, especially as the range they may cover is considerable. The makers of this experimental tank are Messrs. Kelso & Co., electricians and model makers, Glasgow.

In this connection Messrs. Kelso & Co. have just received an order for all the apparatus for an experimental tank, which is to be constructed at the works of a leading Japanese ship building firm. The name of the firm has not yet been officially divulged, but it is almost certain to be the Mitsu Co., of Nagasaki. This is the principal ship building firm in Japan, and during recent years extensive improvements have been made at their works.

The new tank for the Japanese is to be practically a duplicate of that recently constructed in the yard of Messrs. John Brown & Co., Clydebank. It will have a water way about 445 ft. in length, of which 400 ft. is deep varying from 9 ft. at one end to 10 ft. at the other. The breadth will be uniformly about 20 ft. and it will be provided similarily with small wet and dry docks, and all the necessaries detailed in that at Clydebank. The making of the actual tank and the building covering it will be done by Japanese contractors, but otherwise everything will be supplied by Messrs. Kelso, their contract including not only the carriage and recording apparatus, but also the dynamos and the model cutting machinery, and even the rails on each side of the tank, on which the carriage supporting the apparatus will run. The intention of the firm is that everything shall be in working order and capable of being tested in Messrs. Kelso's shop before being sent to Japan. Like the Clydebank tank that in Japan will have apparatus worked by electricity.

MEASURING A VESSEL'S TONNAGE.

Eugene Tyler Chamberlain, commissioner of navigation, Washington, D. C., has recently rendered an opinion to the surveyor of customs, Memphis, Tenn., which is of interest to vessel owners generally. The opinion is rendered in the case of the sternwheel river steamer Dardonelle. This steamer has a freight space, boiler space and engine room on the main deck. The spaces are open at the side and forward and are roofed over or covered by a canopy or shade deck, supported by stanchions not having a direct bearing upon the frames. The spaces are open to the sea and weather and the deck above them is apparently not a deck to the hull within the meaning of the custom regulations of 1899. The engine room is enclosed. The question whether the freight space should be measured for inclusion in such a vessel's tonnage has been submitted to various collectors located on the Mississippi river and its tributaries, the great lakes and the coast. Dissimilar opinions have been expressed, the majority of collectors holding, however, that the spaces are exempt from measurement. Among these are the custom officers at principal ports, including New York, Philadelphia, Cleveland and St. Louis. Commissioner Chamberlain decided that the spaces in question should not be measured or included in the vessel's tonnage. Were the sides boarded up or enclosed so as to protect the freight carried from the sea and water the freight space would be measurable, although it might be open at the forward end.

Joseph R. Oldham, superintending and consulting engineer, well known on the great lakes, announces that he has opened an office at No. 1005 Monadnock building, Chicago, Ill.

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DUTCH SCHOOL FOR MARINE ENGINEERS.

When not long ago the Nieuw Amsterdam, of the Holland-American Line, came to New York, it was learned that this boat, as well as her engines, had been built in Belfast. Another Dutch steamship company has for years been in the habit of replenishing its supply of boats from Sunderland ship yards.

As soon as a new steamer has been ordered the Dutch company generally sends a captain and an engineer to England to be continuously on hand during the period of the vessel's, and the engine's, construction.

These representatives of the steamship company notify the home office as soon as the boat is ready for deliverance, and a full crew is then furnished transportation to the English ship yard. In years gone by the Dutch officials had to recruit their engineers from the machine shops, and while they by so doing secured efficient mechanics, men who were able to repair damaged parts of the machinery, they were not always successful in hiring engineers. And incidentally it may be acknowledged that both engineers and machinists cannot fail to see the distinction and the difference. In order to be able to send engineers to England whenever a boat built in that country for a Dutch firm needed a crew, a now flourishing school for engineers was opened in Amsterdam some years ago. Young men between the ages of 17 and 20, preferably those having already been employed in machine shops, if able to pass the examination, mental and physical, and to pay the moderate fee for two years' tuition, are enrolled as prospective handlers of the engines of Holland's merchant marine. During three days of the week pupils, dressed in natty uniforms, occupy school benches while they are being theoretically instructed in the mysteries of their future calling. And, as has been said above, the engine which later shall be given into their care being generally manufactured in England, the English language is taught in this Dutch school.

Then the remaining days of the week see all the pupils in overalls, either in the blacksmith shop or at the bench, repairing odds and ends of machinery under the supervision of carefully selected instructors.

Those passing the rather difficult examination at the end of the two years' term never experience much difficulty in securing employment in some steamship's engine room.

A few of the pupils have been known, after the completion of their school term, to work as apprentices in an English machine shop. But as an English apprentice earns only about six shillings per week it should here be added that, however desirable such a course may prove in the end, only the wealthier members of the class can avail themselves of this opportunity to further their prospects for the future.

In years gone by the officials of Dutch steamship companies generally secured their engineers by a process of elimination. It was about similar to the rule to which somebody once reduced sculpture: "Just take a block of marble and knock away those parts which you do not want." In other words, the company hired a lot of mechanics, and discharged those among them of whom they despaired of ultimately making engineers. But that is now changed—the school's certificate ensures the possessor immediate acceptance by a steamship company that needs an engineer. Over sensitive patriots originally objected to the use of English in a Dutch school. But as French is still the language of diplomacy, and learned by those who deem fit to have their education provided with the acknowledged superior trimmings, so English is the language of the sea.

A French and a German mariner use the English language when extending greetings one to the other. And, besides, England is the birthplace of the majority of the engines installed in Dutch ships.

What more natural than that the future "chiefs" of those engines become conversant with the English tongue. Far better, from the standpoint of a Holland patriot, to have Dutch engineers in their steamers, even should they be able to speak English, than, as was the case some years ago, when a large Dutch mail boat sailed to East India with a British engineer in charge of the engine room.

He may have been able to speak English; he certainly spoke Scotch, but he could not speak Dutch. F. H.

AROUND THE HORN WITH A GREEN CREW.

The stately old clipper ship M. P. Grace, after thirty-six years of buffeting with the seven seas, swings at her anchor off Quarantine says the New York *Evening Post*, just in from a 136-day voyage around the Horn from Port Townsend with every mast and stick, rope and spar, in position and her bottom as tight as a cup defender's. She makes a refreshing contrast in the marine 'scape of the bay, showing up to decided advantage beside the groups of smutty coal barges and dirty German and English tramps, with here and there an occasional schooner, brigantine or bark.

The old salts who spend the eventime of their lives along the dock front of Tompkinsville, gazing over the constantly shifting scenery of the water front, fondled their little black cuddies contentedly and exchanged reminiscences of the days of the old Black Ball packets and the time when the swiftest ships and the cleverest captains on the seas under American colors kept the world on edge by their daring pace making. Her lofty royals with their yards cock-billed, and gracefully tapering spars, rise high above the hamper of her surrounding mates, so that for miles down the bay the mazy tangles of her rigging greet the eyes of curious multitudes on hurrying modern ferryboats and incoming ocean liners.

"What kind of a trip did we have?" repeated the bronzed old mate. "Well, I guess it was what you might call an uneventful v'yage—leastways most of the way. Once in a while things got interestin', but here we are, from Port Townsend in 136 days, and nary a rope or spar missin', an' blame, if the old hooker ain't got as sound a bottom as a Dutch beer keg—barrin' once or twice, just a little bilge leakin' in, we ain't never had to use the pumps. How do you account for our luck? H'm, good crew—purty green, tho'—an' a dam' good ship. They don't build ships like the old Grace no more, principally because they don't pay, I suppose, but I can't see why not, myself. We ain't never had no trouble with her, an' she's reliable 's they make 'em.

"Oh, well, the time of sailing ships an' sailormen is over, I guess. They ain't no more American ships nor no more American sailors—nothin' but lot of fool foreigners as don't know a scuttle butt from a bilge plank, nothin' but the way to trim coal an' ile ingines. Yes, sir, that's what the present kind of sailorman 's becomin' and I'm thankful he ain't an American.

"Well, sir, we had bully good weather comin' down the sound—that was just about the time of that big steamer disaster they had out there—an' likewise comin' down the coast, good winds an' not too heavy, and we simply roared along under big canvas. In these bloody days of socialism, unions, and gen'rally confounded tom-foolery, they've even got sailors' unions, an' in consekence its purty nigh impossible to ship a decent crew. Thusly we put out of Townsend with fifteen men—harf of 'em green boys, kids of sixteen or eighteen, as may have known how to milk a cow, but couldn't tell the stern from the main tops'l yard—and only two Americans in the hull crowd. It's fair to say, tho', that they was all willin' to work, but you can bet anythink you like, they'd have worked whether they liked it or not. Why, I

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had to put the different ropes in their hands and tell 'em what to do, and it was two weeks before I dared to send 'em up the crosstrees—me not wishin' to have murder on me soul. What are you goin' to do with the likes of that? Have patience, you say. And I did. Never was so patient a man. An' yet they'll tell you that American ships are floatin' hells and American masters slave drivers, an' their officers nothin' but apostles of the rope's end.

THE HORN IS NO BOUDOIR.

"Lucky it was, too, we had that spell of easy weather to break 'em in, for as we made latitude the breezes grew with it, an' long before we ran by the straits, they was a-blowin' a gale. The weather veered right around then—it was late in May—an' grew cold as the devil. Of course, you know, only steamers go through the straits, so we had to keep on makin' southin', until we got where we could claw 'round—it bein' easy to see, sir, from what you learns in your jog'rafy at school, that Cape Horn ain't no lady's boudoir for restful ease.

"All the time the wind blew harder an' harder, an' then it began to snow. The owners rigged us out with a donkey puffer an' reduced the crew five men before we sailed, hopin', I s'pose, to save expense; but my opinion of donkey ingines for histin' sails on full riggers ain't very high. They may do on schooners, but not on square-riggers, like the Grace, they're more useful 's ornaments.

HURRICANES FOR THE GREENHORNS.

"So, there we was, with the wind blowin' hurricanes, snow an' sleet comin' down in bunches that hid the bowlights from the quarterdeck, a deck load of Oregon pine level with the rail, so it left no guard between the men an' the sea, 'ceptin' a little temp'ary affair of boards we rigged up; an', mind you, with all this, a crew of green boys to send onto the yards. As the wind increased we had to take in sail, and finally we got down to the two tops'ls, and by jiminy, but she did hum under 'em. A good thirteen knots we reeled off most of the time, an' the lee rail was white with foam.

"When we were right south of the Cape, the snow flurries increased, an' it was waist high on the decks. The old man ordered life-lines stretched, an', I tell you, we needed 'em. How on earth some of those greenhorns didn't go overboard is one of these dispensations of Providence that air above the level of poor sailormen. There was one night in partikler that I remember. The gale was a-roarin' behind us, drivin' the old hooker's nose into smothers of foam ev'ry minit an' pilin' the water in heaps, like the collar on a glass of lager, all over the lee side. What of her that wasn't covered with foam was buried in snow an' sleet. We was just drivin' blindly into the snow wall ahead of us. We couldn't have seen another vessel if she'd been within a half-length of us.

There wasn't nothing about us but snow, an' ev'ry now and then particles of hail whipped out of it an' stung into our faces. Suddenly I heard a whirrin' right above me in the air. I looked up, but I couldn't see nothin' at first—then, I made out a dark shadow, a shadow that was movin' somewhere up in the riggin'. The whirrin' got nearer, an' the shadow got darker, an' fust thing I knew a big albatross that must have measured fourteen feet from wing to wing, flashed out of the whiteness almost into the steersman's face. Huh! you'd a thought he'd seen a ghost.

"After we got out of the storm zone we had an easy time of it—fair wind and fair weather until we struck the tropics again an' then we picked up the trades an' made fust rate time over the equator, with cool breezes an' nary a man sick. We sighted almost our furst ships along this away. Yes, it seems a shame to break an old flyer like this up, but that's what they're a thinkin' of doin' so I understand,—goin' to make a coal barge out of her. What d'you think of that? It seems like they might leave her live out her life nat'ral like after she's done so well so many years."

HARRIMAN PURCHASES MORE STEAMSHIPS.

The Pacific Mail Steamship Co. has just added to its fleet two of the best known steamships on the Pacific. The official announcement has just been made that the Harriman corporation had purchased from the White Star line, of Liverpool, England, the liners Coptic and Doric.

When the Coptic left San Francisco it was supposed that she was making her last trip out of that port, and that from Hongkong she would return to England. Before she sailed there were rumors of her possible return. These rumors are now confirmed, and both the Coptic and Doric will hereafter sail under the Pacific Mail Steamship Co.'s well-known colors. Both will remain under the British flag.

Although not new vessels, the Coptic and Doric are both in first-class condition. The Coptic was built in 1881 at Belfast by Harland & Wolff. She is a vessel of 4,356 gross registered tonnage. The Doric is larger than the Coptic, her gross tonnage being 4,680. She was also built at Belfast in 1883.

The purchase of the Coptic and Doric will leave the Occidental & Oriental Steamship Co. without a ship and its officers without occupation. It is understood, however, that the officers will be taken care of by the Harriman corporation, of which the Occidental & Oriental Co. was merely an adjunct.

It is stated on what is deemed reliable authority that the Harriman interest has also recently purchased the two steel steamships Breakwater and Czarina. These vessels both belong to the Spreckels Co. and are rather small, though comparatively new and very seaworthy. This reported purchase as yet lacks positive official confirmation. However, it is very generally believed in commercial circles.

It has long been known that the Harriman corporation stands in pressing need of more steamers to handle the sea traffic. Within the last two years two good vessels were lost—the steamers Geo. W. Elder and the St. Paul. The steamer Columbia has been out of commission for months. This vessel was in the Union Iron Work's dry dock undergoing a general overhauling at the time of the great earthquake of April 18. The Columbia was pitched from the blocks, thrown over on her side, a number of large holes punched in her steel hull, and her upper very badly wrecked. This vessel, however, will very soon be placed in active commission. Harriman has been decidedly unfortunate with his steamers.

AMERICAN NAVY SAFETY APPLIANCES AT MILAN.

One of the few American exhibits at the Milan exposition, now open for the season of 1906, is that of the "Long Arm" system of electrically operated bulkhead doors. The exhibit consists of a horizontal sliding door, a vertical sliding door, a hatch gear and the electrical emergency station from which, aboard ship, all important bulkhead doors and the armor hatches are operated. The types of doors and the hatch forming this exhibit are all of the latest model. A great deal of interest has been manifested in Italy in the "Long Arm" system, which is in use on all the new warships of the United States navy, and it is doubtless somewhat due to the educating influence of this exhibit that a movement has been started in Italy to have incorporated in the governmental regulations for passenger ships a clause making the installation of power doors obligatory.

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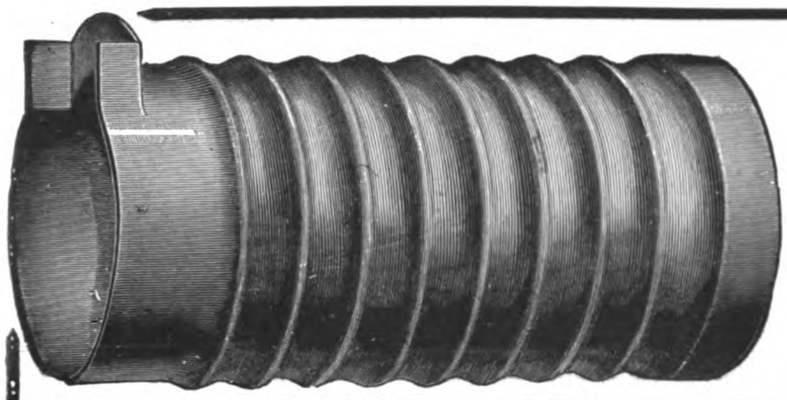

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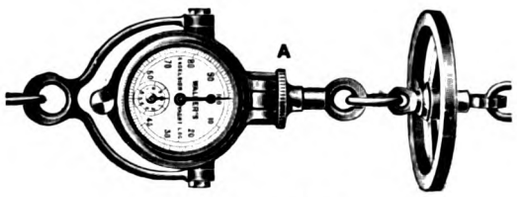

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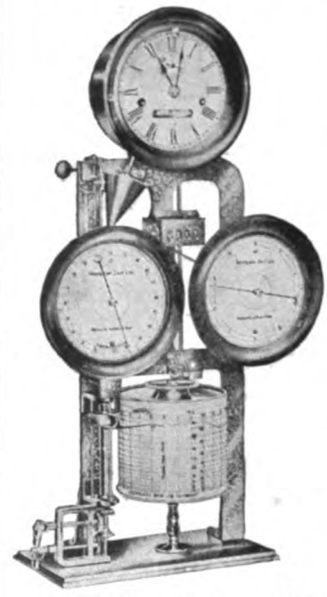

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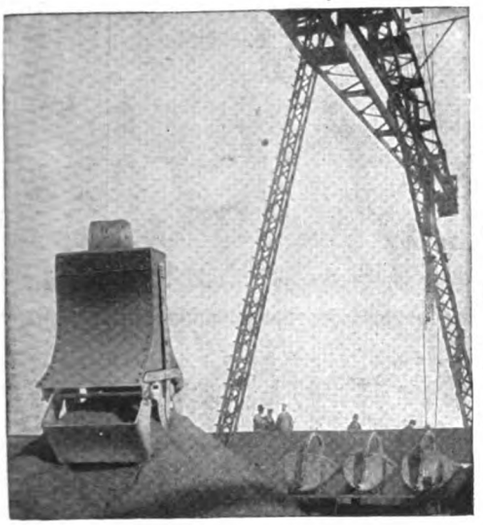

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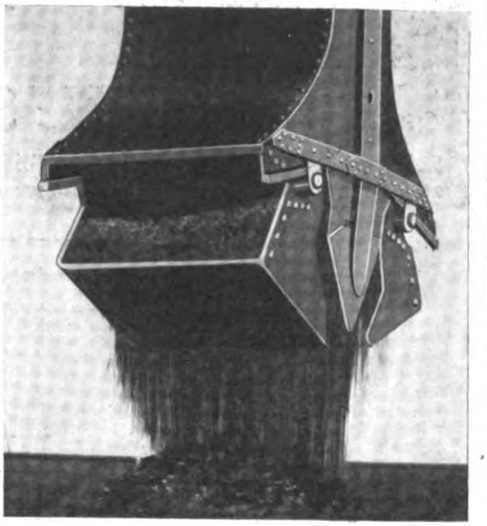

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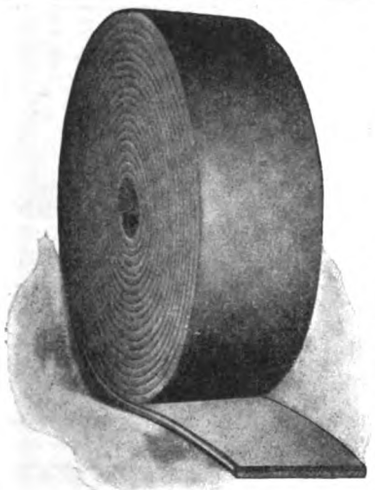

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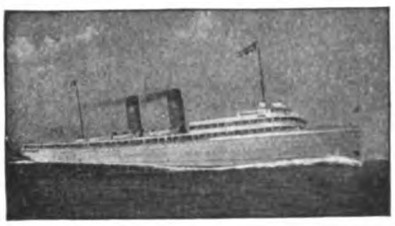

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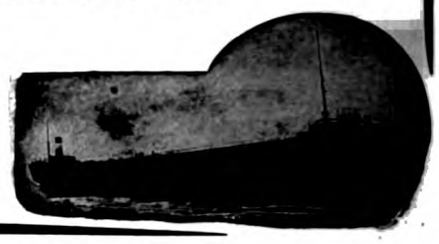

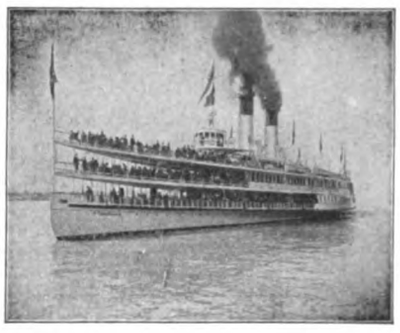

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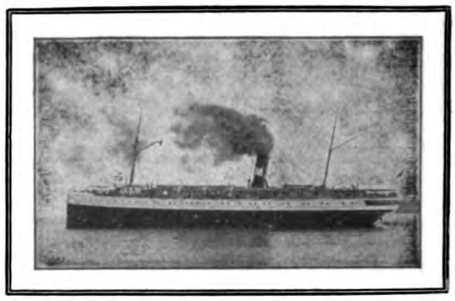

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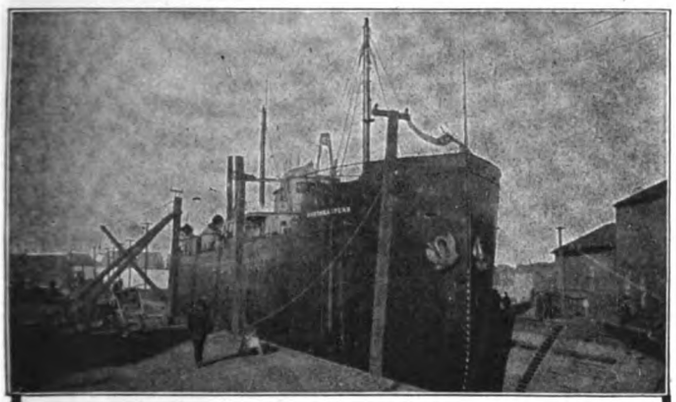

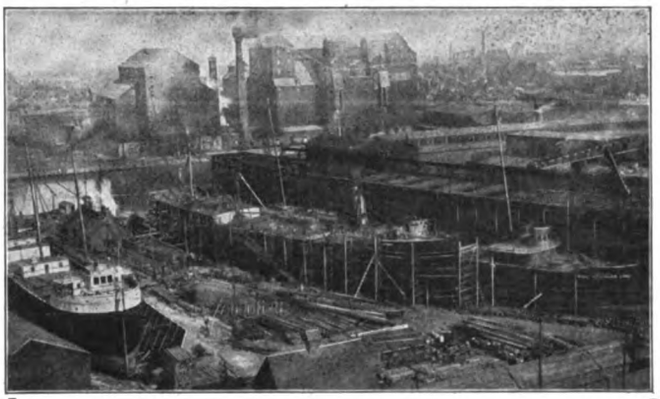

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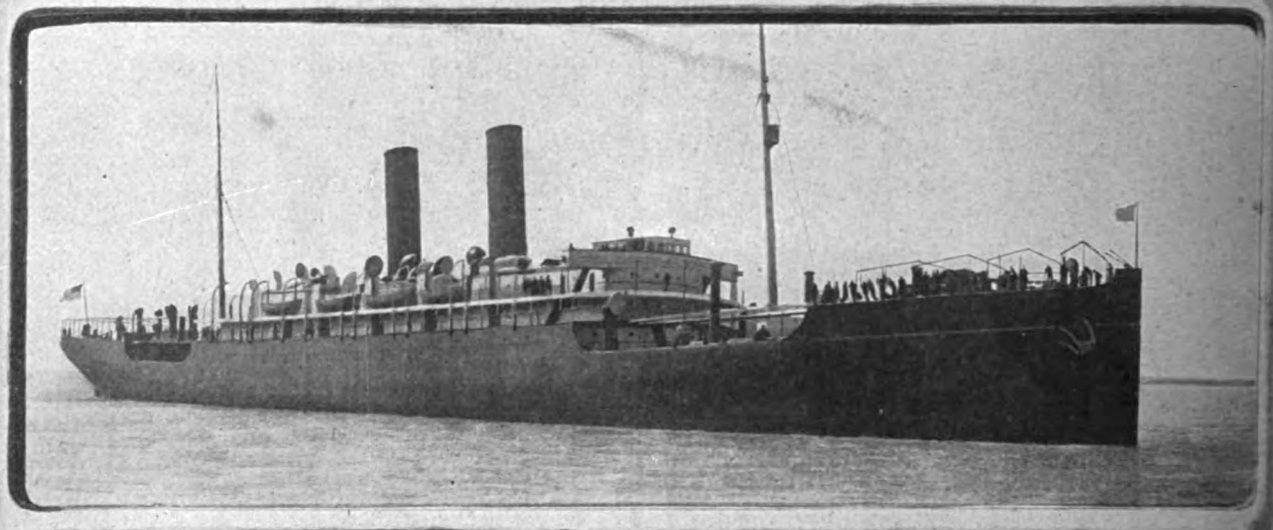

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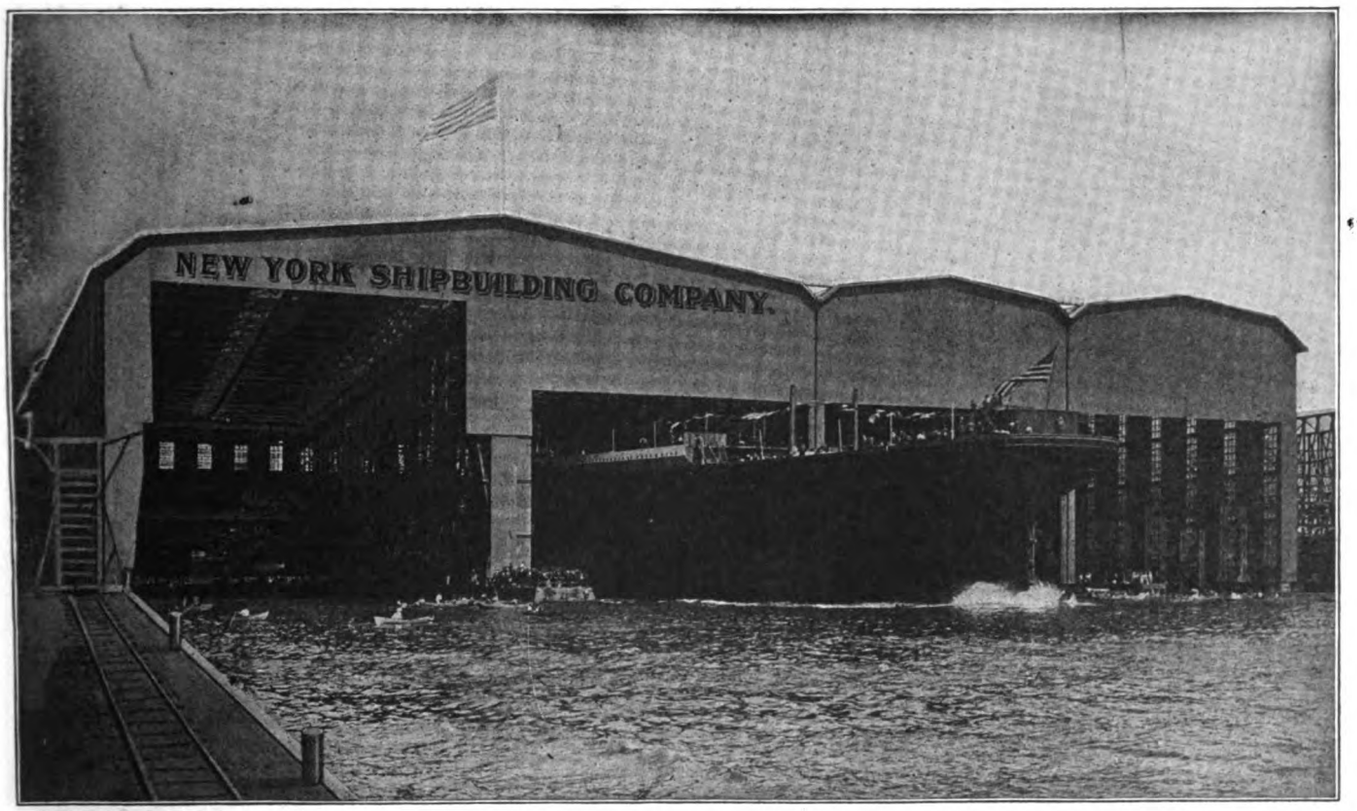

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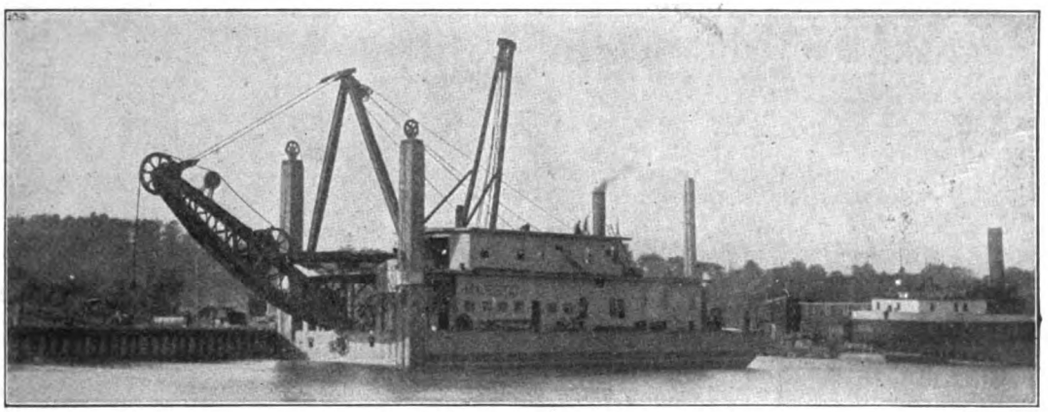

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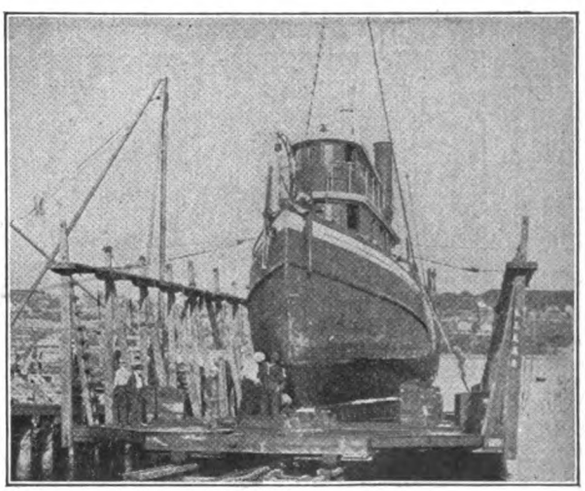
The Wrecking Steamer FAVORITE, Alex. Cunning, Master, will be stationed during season 1906 at ST. IGNACE, MICH. A Long-Distance Telephone has been installed on board the steamer. When at her home dock, the steamer can be reached by telephone any time day or night, 'Phone Number 63, and in absence of steamer full information as to the steamer may be obtained by telephoning to residence of Capt. Cunning, St. Ignace.

The Favorite and her equipment were thoroughly overhauled during the past winter, and are in first class condition to do outside work.



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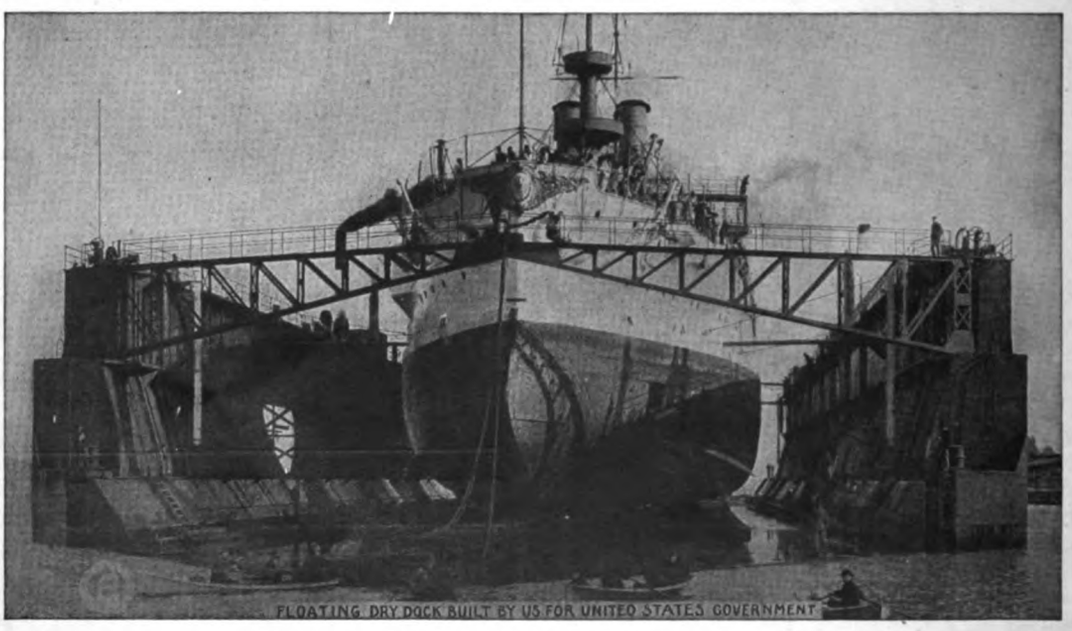

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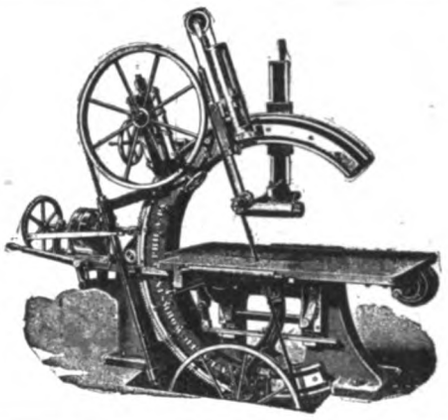

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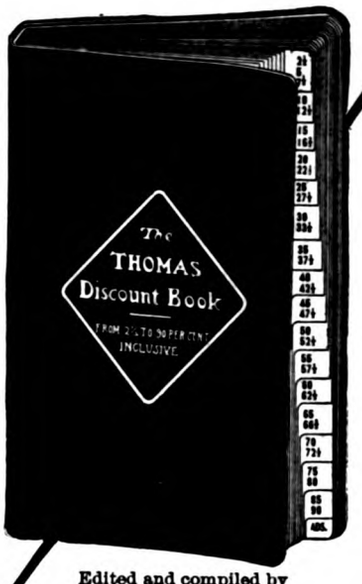

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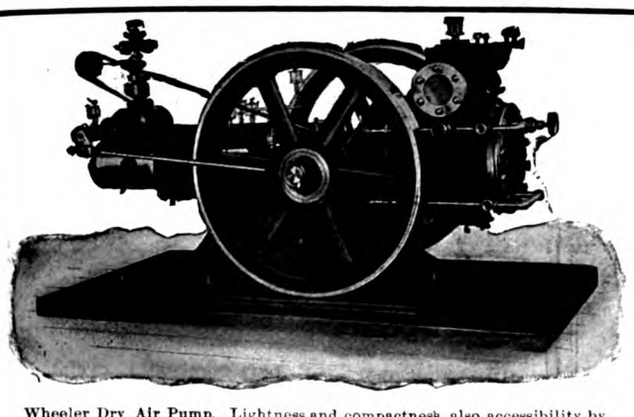

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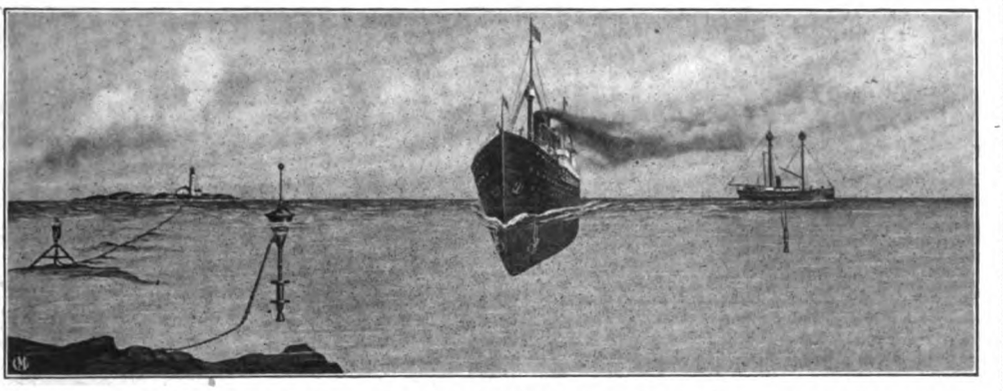

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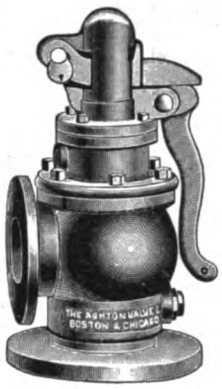

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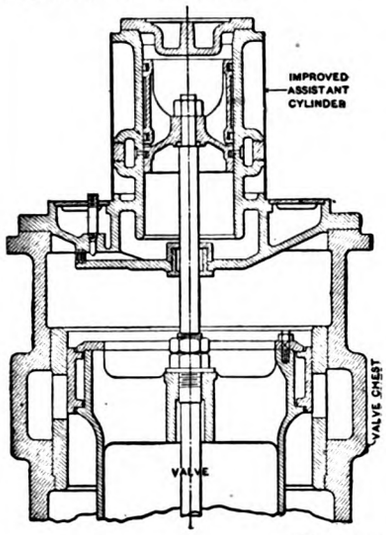
The Lovekin Improved Assistant Cylinder for Valve Gears (Patented)

NOTE!! See papers read before American Society of Naval Architects and Marine Engineers, Nov., 1902. Prize awarded for this article. Also see "Journal of the American Society of Naval Engineers," Vol. XVI. No. 3.



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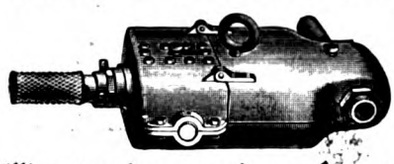

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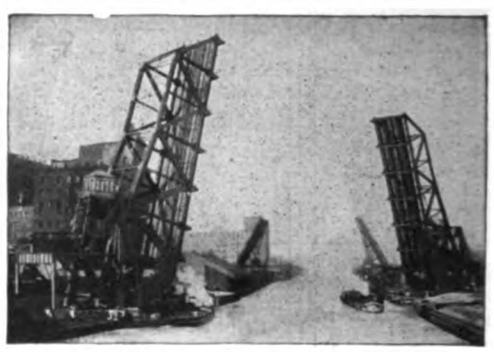

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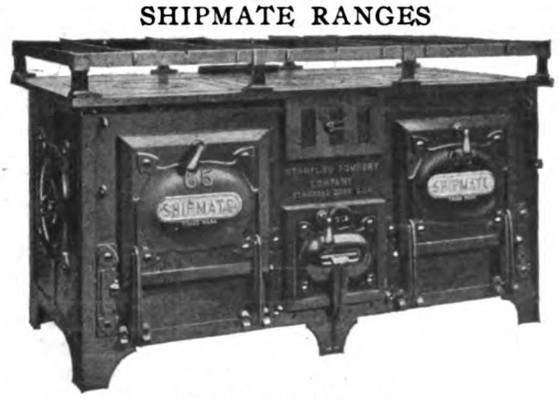

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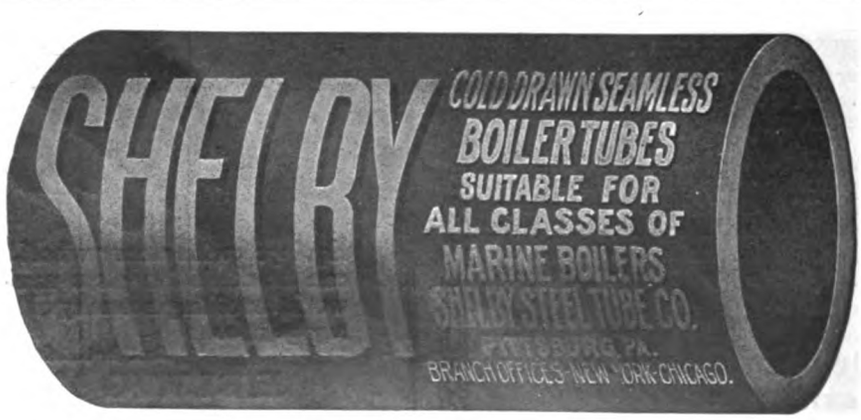

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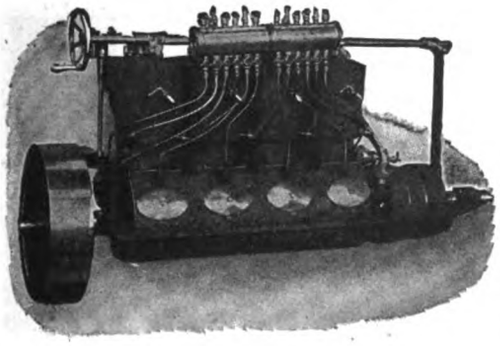

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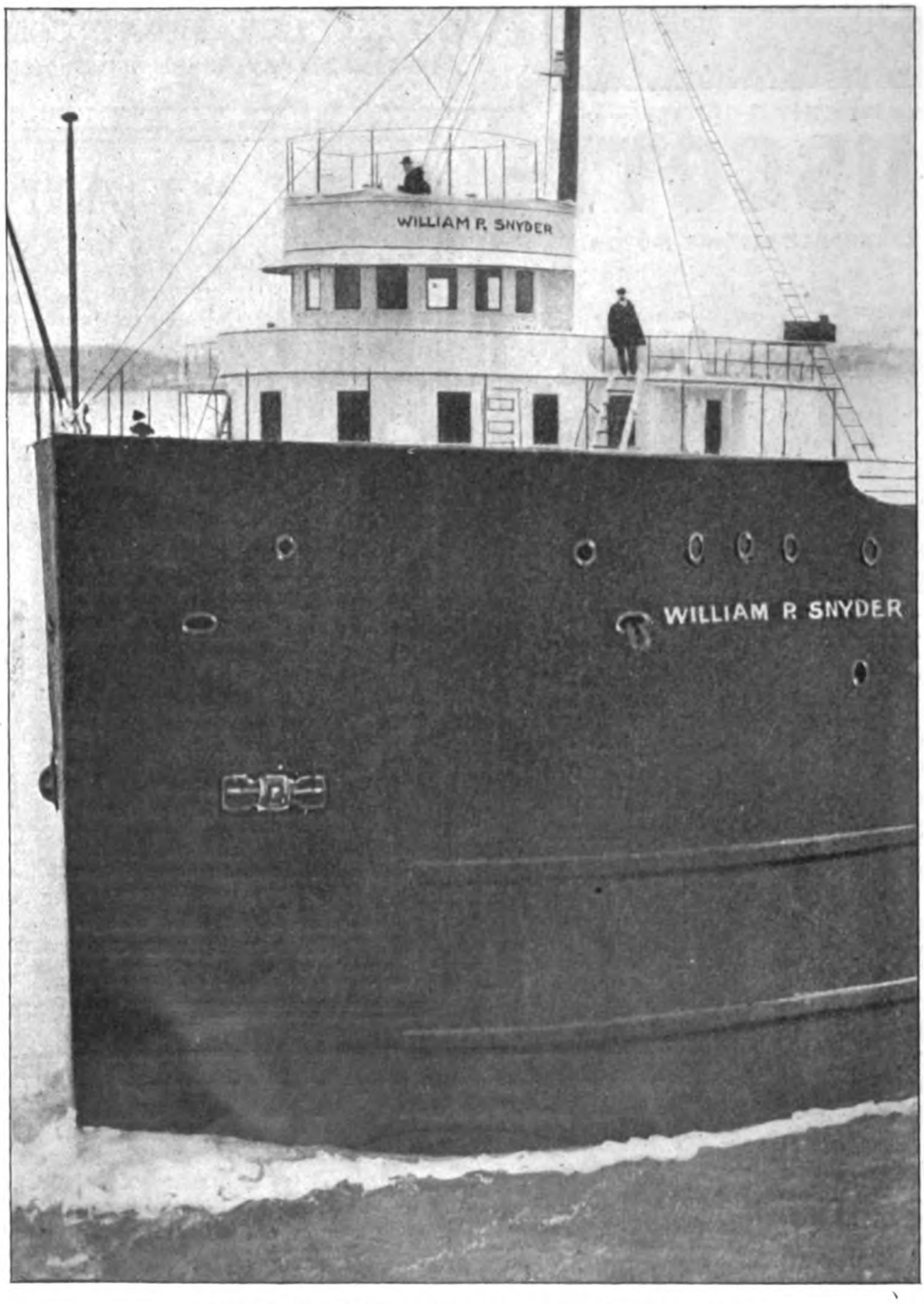

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550 Feet Long, 56 Feet Beam.

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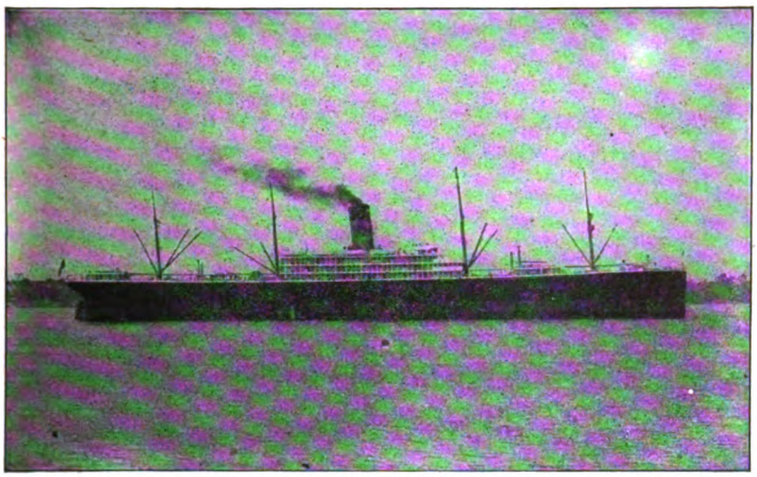

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WANTED and FOR SALE Department.

PROPOSALS.

Treasury Department, U. S. Life-Saving Service, Washington. D. C., July 25, 1906. Sealed proposals will be received at this office until 2:00 o'clock p. m., of Tuesday, August 14, 1906, and then publicly opened, for the construction of a life-saving station in Jackson Park, Chicago, Illinois. Specifications and drawings, forms of proposals, etc., can be obtained upon application to the Superintendents of Construction of Life-Saving Stations, 379 Washington street, New York City; to the Assistant Inspector of the 12th Life-Saving District, Room 500, Federal Building Chicago, Illinois; or to this office. O. M. Maxam, Acting General Superintendent.

FOR SALE.

Barge for Sale.

Sand and gravel barge, 150 ft. long, 24 beam, good condition throughout, 10-in. centrifugal pump, steam hoist, shovels and full equipment; will accept exchange. Address Drawer "C," Sarnia, Ont.

For Sale, Tug Gladiator.

Length, 115 ft.; breadth, 22 ft.; depth, 12 ft. Steeple compound engine 22 x 42 x 30. Housed in forward. Tug can be seen under working conditions at Duluth, Minn., by applying to Split Rock Lumber Co., Duluth, Minn.

STEAMER WANTED.

I wish to purchase an iron or steel steamer of about 1,000 net tonnage. State lowest cash price. Address, J. E. P., care MARINE REVIEW, Cleveland, O.

FOR SALE.

For Sale.

Five Scotch Boilers, allowed 160 lbs, steam. Good as new. ERIE MACHINERY CO., 729 Garfield Bldg., Cleveland, O.

For Sale.

1,000 h. p. fore and aft Neafie & Levy compound Engine; surface condenser; independent pumps.
Two 12-foot Scotch Boilers.
One 13½-foot Scotch Boiler.
One 10 16-25 x 16 triple expansion Engine.
Three 150-h. p. Almy Boilers.
One 200-h. p. Tregurtha Boiler.
One 14 30 x 24 fore and aft Engine and condenser.
One Williamson steering Engine.
One 10 k. w. electric lighting Set.
One 15 k. w. electric lighting Set.
One Providence Windlass, 50 fathoms 1½ in. chain.
Two thrust Shafts and Bearings, 8½ in. diameter.

MARVIN BRIGGS,
17 Battery place, New York, N. Y.

Steamer T. S. Christie.

Length 160 ft.; beam 30 ft.; carrying capacity, lumber 525,000 ft., coal 800 tons. Rating in Inland Lloyds Register, A1½*, valuation $22,000. For price and particulars address Capt. P. Larsen, Box 249, Chicago, Ill.

FOR SALE.

Steamer for Sale Cheap.

The lighthouse steamer Haze, 145 ft. long, 27-ft. beam, 9-ft. draught, 500 tons capacity, 300 horsepower engine and boiler, suitable for passenger or freight business, fully equipped. Steam capstan, donkey boiler. Jacob Ullman, 46 Lloyd street, Buffalo, N. Y.

FOR SALE.

Three yard clam shell dredge in fine order rigged to work as dipper machine.

Machinery for one other dredge. 14 x 16 tug. Lying at River Rouge, Mich.

W. S. CARKIN,
Bennington, N. H.

For Sale or Charter for the Season.

Commodious Steam Yacht, 75 ft. long, 18 ft. beam, 6½ depth of hold. Two staterooms and finest outfit, including electric light plant, search light, and power launch. Triple expansion engine, safety boiler. Cheap and easy steamer. Inquire of R. J. Cram, Port Huron, Mich.

WANTED

WANTED.—Scow to carry 500 to 700 tons on deck. Address Patrick Koehane, Lorain, Ohio.

GREAT LAKES REGISTER

FOR THE
CLASSIFICATION OF STEEL AND WOODEN VESSELS.

Estb. 1828 — Estb. 1896

COMBINED AND ISSUED IN CONNECTION WITH

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F. D. HERRIMAN, SURVEYOR GENERAL,
320-322 Perry-Payne Building, - - - CLEVELAND, O.

Centrifugal Dredge For Sale

(Canadian)

Twelve inch suction and discharge. Fore and aft compound engine. All in first class condition.

For particulars address:

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Toronto, Canada

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Insurance Brokers. Average Adjusters.

ESTABLISHED 1870.

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C. T. BOWRING & CO., (Insurance) LTD.,
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We Represent Only the Assured.

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FOR SALE

We have on hand at Ambridge, Pa., for immediate delivery, one steel barge of which the following is a general description :

Length over all	-	**173′ 0″**
Breadth (Moulded)	-	**26′ 0″**
**Depth " **	-	**10′ 0″**

The barge is of the open hold type with a twelve-in. (12″) deck side stringer forming a gangway at each side. The bilge or knuckle of this barge is rounded off to a radius of 12″, this construction being carried up rake to deck. The ends in elevation are rounded off forming rake of about 10′ 0″ radius. At each end at foot of rake, a steel, watertight collision bulkhead is fitted, forming with the rake framing a substantial construction for towing purposes. Heavy cross beams are fitted about 30′ 0″ apart and at tow posts. The ordinary transverse framing is spaced about 2′ 0″ apart and deep floors and web frames are arranged about 15′ 0″ apart and at tow posts.

At the ends, a working deck is fitted and an ample number of towing posts are provided for the proper handling of the barge. A rubbing strake is fitted on the side and ends of this barge and two pump casings or boxes are provided. This barge is well adapted for carrying bulk cargoes such as coal, etc., but it should be noted that there is no wood ceiling laid on floors. The carrying capacity in short tons on a fresh water basis is as follows :

At 8′ 0″ draft	-	**970 tons.**
At 6′ 0″ draft	-	**700 "**

For price and further particulars apply to the

American Bridge Co. of New York

FRICK BUILDING

PITTSBURG, PA.

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For a more complete classification than that represented by advertisers in The Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, Marine and Naval Directory of the United States, published by The Marine Review, Cleveland.

[See accompanying Index of Advertisers for full addresses of concerns in this Directory.]

AIR COMPRESSION, HOISTS.
Great Lakes Engineering Works....Detroit.

AIR PORTS, DEAD LIGHTS, ETC.
Marine Mfg. & Supply Co.....New York.

AIR PUMPS AND APPLIANCES.
Fore River Ship & Engine Co.....Quincy, Mass.
Great Lakes Engineering Works....Detroit.

ANCHORS.
Bowers, L. M. & Co.....Binghamton, N. Y.

ANTI-FRICTION METALS.
Cramp, Wm. & Sons....Philadelphia.

ARTIFICIAL DRAFT FOR BOILERS.
American Ship Building Co.....Cleveland.
Detroit Ship Building Co....Detroit.
Great Lakes Engineering Works....Detroit.

ASH EJECTORS.
Great Lakes Engineering Works....Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.
Gilchrist, Albert J.....Cleveland.
Goulder, Holding & Masten.....Cleveland.
Hoyt, Dustin & Kelley....Cleveland.
Jenkins, Russell & Eichelberger....Cleveland.
Kremer, C. E. .....Chicago.
MacDonald, Ray G.....Chicago.
Shaw, Warren, Cady & Oakes.....Detroit.
White, Johnson, McCaslin & Cannon.....Cleveland.

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons.....Brookline, Mass.

BELTING (LEATHER.)
Republic Belting & Supply Co.....Cleveland.

BLOCKS, SHEAVES, ETC.
Boston Lockport Block Co.....Boston, Mass.

BOAT BUILDERS.
Drein, Thos. & Son.....Wilmington, Del.
Kahnweiler's Sons, David.....New York.
Marine Construction & D. D. Co....Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

BOILER COMPOUNDS.
The Bird-Archer Co.....New York
Dearborn Drug & Chemical Works.....Chicago.
Lake Erie Boiler Compound Co.....Buffalo
State Manufacturing Co...Cleveland.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co.....Providence, R. I.

BOILER MANUFACTURERS—Continued.
American Ship Building Co.....Cleveland.
Atlantic Works..East Boston, Mass.
Chicago Ship Building Co..Chicago.
Cramp, Wm. & Sons..Philadelphia.
Dearing Water Tube Boiler Co.....Detroit.
Detroit Ship Building Co....Detroit.
East End Boiler Works....Detroit.
Fletcher, W. A. & Co.....Hoboken, N. J.
Fore River Shipbuilding Co.....Quincy, Mass.
Great Lakes Engineering Works....Detroit.
Kingston Foundry & Machine Works .....Oswego, N. Y.
Maryland Steel Co.....Sparrow's Point, Md.
Milwaukee Dry Dock Co.....Milwaukee.
Mosher Water Tube Co..New York.
Newport News Ship Building Co..Newport News, Va.
New York Shipbuilding Co.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co.....Duluth, Minn.
Quintard Iron Works Co.....New York.
Roberts Safety Water Tube Boiler Co. .....New York.
Superior Ship Building Co.....Superior, Wis.
Taylor Water Tube Boiler Co....Detroit.
Toledo Ship Building Co.....Toledo.

BOILER RIVETS.
Bourne-Fuller Co.....Cleveland.

BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.....Cuyahoga Falls, O.

BRASS AND BRONZE CASTINGS.
Cramp, Wm. & Sons....Philidelphia.
Fore River Ship & Engine Co.....Quincy, Mass.
Great Lakes Engineering Works..Detroit.
Lunkenheimer Co.....Cincinnati.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co....Chicago.

BUCKETS, ORE AND COAL.
Brown Hoisting & Conveying Machine Co.....Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co.....Cleveland.

CANVAS SPECIALTIES.
Baker & Co., H. H.....Buffalo.
Bunker, E. A.....New York.
Upson-Walton Co.....Cleveland.
Republic Belting & Supply Co....Cleveland.

CAPSTANS.
American Ship Windlass Co.....Providence, R. I.
Dake Engine Co.....Grand Haven, Mich.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....New York.

CEMENT, IRON FOR REPAIRING LEAKS.
Smooth-On Mfg. Co.....Jersey City, N. J.

CHAIN SURVEYORS, HOISTS.
Brown-Hoisting Machinery Co.....Cleveland.
General Electric Co.....Schenectady, N. Y.

CHAIN HOISTS.
Boston & Lockport Block Co.....Boston, Mass.
Republic Belting & Supply Co.....Cleveland, O.

CHARTS.
Penton Publishing Co....Cleveland

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.
Ritchie, E. S. & Sons.....Brookline, Mass.

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Hanna, M. A. & Co.....Cleveland.
Pickands, Mather & Co....Cleveland.
Pittsburg Coal Co.....Cleveland

COAL AND ORE HANDLING MACHINERY.
Brown-Hoisting Machinery Co.....Cleveland.

COMPASSES.
Ritchie, E. S. & Son.....Brookline, Mass.

CONDENSERS.
Great Lakes Engineering Works....Detroit.
Thropp & Sons Co., John E.....Trenton, N. J.
Wheeler Condenser & Engineering Co.....New York.

CONTRACTORS FOR PUBLIC WORKS.
Breymann Bros., G. H.....Toledo.
Buffalo Dredging Co.....Buffalo.
Dunbar & Sullivan Dredging Co....Buffalo.
Great Lakes Dredge & Dock Co....Chicago.
Hickler Bros.....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich
Smith Co., L. P. & J. A...Cleveland.
Starke Dredge & Dock Co., C. H...Milwaukee.
Standard Contracting Co..Cleveland.
Sullivan, M.....Detroit

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Upson-Walton Co.....Cleveland.

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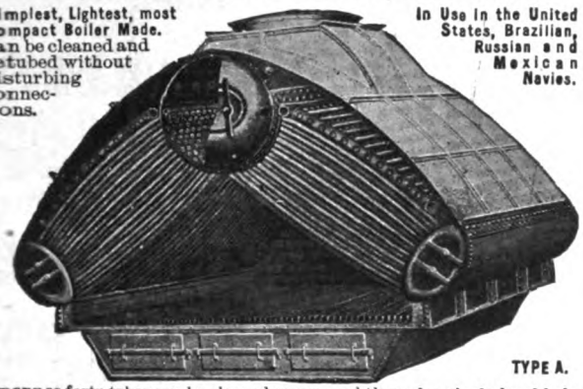
THE MOSHER PATENT WATER TUBE BOILER

Simplest, Lightest, most Compact Boiler Made. can be cleaned and retubed without disturbing connections.

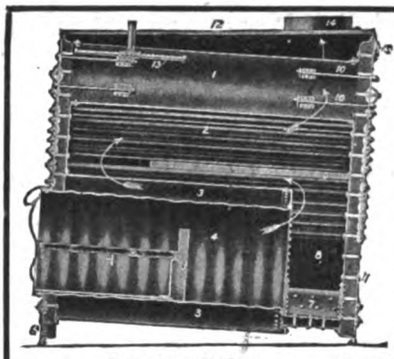
In Use in the United States, Brazilian, Russian and Mexican Navies.



TYPE A.

As many as forty tubes can be cleaned or renewed through a single hand-hole; has greater steam and water capacity than any other water tube boiler. Send for descriptive catalogue.

MOSHER WATER TUBE BOILER CO., NO. 1 BROADWAY, N. Y.



Detroit Scotch Water Tube Boiler

Internally Fired.

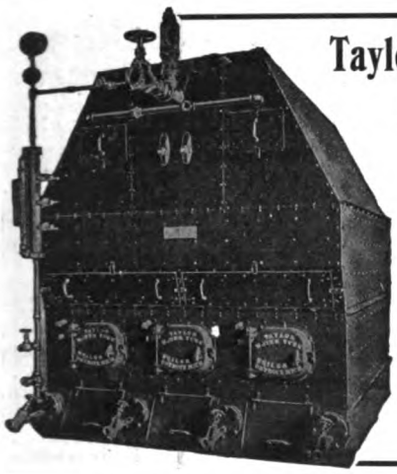
Scotch and Water Tube types combined, eliminating all objections.

Half the weight of ordinary Scotch boilers.

Standard corrugated furnaces.

Patent applied for. Investigate before buying any other.

EAST END BOILER WORKS
Detroit, Mich.

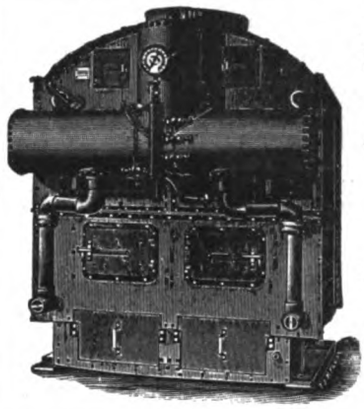


Taylor Water Tube Boiler Co.

Vertical Tubes, sectional, large steam space and liberating area.
Fire box, combustion chamber, and course for the furnace gases similar to the Scotch Marine.
Free circulation type.

Send for full description.

322 Franklin St.
DETROIT, MICH.



350 STEAM VESSELS

Now Equipped With

ALMY'S PATENT SECTIONAL Water Tube Boilers

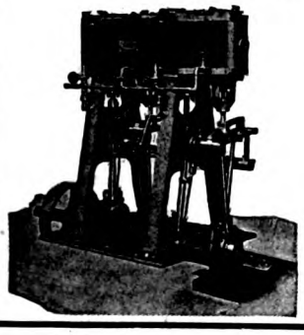
Bear Evidence of Their

Excellent Qualities

ALMY WATER-TUBE BOILER. CO.
PROVIDENCE, R. I.

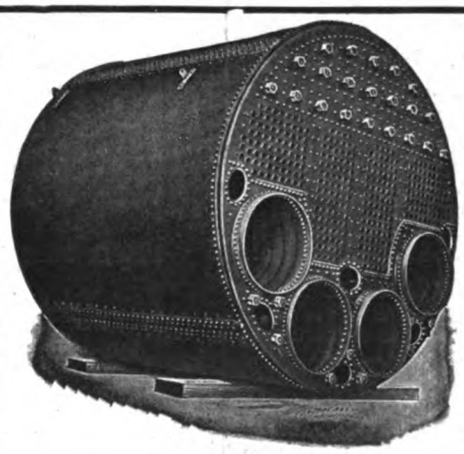
John E. Thropp & Sons Co.

TRENTON, N. J.



Builders of Single, Compound, Triple-Expansion and Direct Connected Engines.

Boyer Sectional Water Tube boilers and machinery complete for light draft Passenger Boats, Yachts, Tugs, Etc.



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OF ALL TYPES

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LATEST PATENT ANCHOR

THE NATIONAL

APPROVED BY LLOYDS.

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ANCHORS.

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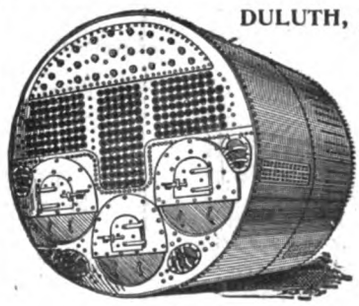
CLEVELAND, O.

Northwestern Steam Boiler & Mfg. Co.

DULUTH, MINN.



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J. H. OPPERMAN, *Secretary*, 579-R; E. KRIZ, *Superintendent*, 557-M.

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.... Cleveland.

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Dunbar & Sullivan Dredging Co....
.... Buffalo.
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.....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich.
Smith Co., L. P. & J. A...Cleveland.
Starke Dredge & Dock Co., C. H...
....Milwaukee.
Sullivan, M..... Detroit.

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Buffalo Dry Dock Co.....Buffalo.
Chicago Ship Building Co.....
.... Chicago.
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Detroit Ship Building Co.....
.... Detroit
Great Lakes Engineering Works....
.... Detroit.
Lockwood Mfg. Co.....
.....East Boston, Mass.
Milwaukee Dry Dock Co.....
....Milwaukee.
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.....Newport News, Va.
Shipowners' Dry Dock Co.Chicago.
Superior Ship Building Co.....
.... Superior, Wis.
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..... Hoboken, N. J.
Toledo Ship Building Co.....Toledo.

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..... Manitowoc, Wis.

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Thropp & Sons, John E.....
....Trenton, N. J.

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General Electric Co.....
.....Schenectady, N. Y.

ELECTRIC LIGHT AND POWER PLANTS.
General Electric Co.....
.....Schenectady, N. Y.
Thropp & Sons, John E.....
.....Trenton, N. J.

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..... Cleveland.
Atlantic Works, East Boston, Mass.
Chicago Ship Building Co., Chicago.
Chase Machine Co.....Cleveland.
Cramp, Wm. & Sons, Philadelphia.
Detroit Ship Building Co., Detroit.
Fletcher, W. & A. Co., Hoboken, N. J.
Fore River Shipbuilding Co.....
..... Quincy, Mass.

ENGINE BUILDERS—Continued.
Great Lakes Engineering Works....
..... Detroit, Mich.
Hall Bros. ..... Philadelphia.
Lockwood Mfg. Co.....
.....East Boston, Mass.
Maryland Steel Co.....
.....Sparrows Point, Md.
Milwaukee Dry Dock Co., Milwaukee.
Mosher, Chas. D.....New York.
Newport News Ship Building Co....
.....Newport News, Va.
New York Ship Building Co.....
.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co. ..... Duluth, Mich.
Quintard Iron Works Co., New York.
Roach's Ship Yard.....Chester, Pa.
Sheriffs Mfg. Co.....Milwaukee.
Superior Ship Building Co.....
..... Superior, Wis.
Thropp, J. E. & Sons Co.....
.....Trenton, N. J.
Toledo Ship Building Co.....Toledo.
Trout, H. G.....Buffalo.

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Marine Mfg. Supply Co., New York.

ENGINEERING SPECIALTIES AND SUPPLIES.
Lunkenheimer Co. ..... Cincinnati.
Northwestern Steam Boiler & Mfg. Co. ..... Duluth, Minn.

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Hynd, Alexander ..... Cleveland.
Hunt, Robt. W. & Co.....Chicago.
Kidd, Joseph.....Duluth, Minn.
Mosher, Chas. D.....New York.
Nacey, James ..... Cleveland.
Roelker, H. B.....New York.
Wood, W. J.....Chicago.

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Wheeler Condenser & Engineering Co. ..... New York.

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General Electric Co.....
.....Schenectady, N. Y.

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Cleveland City Forge & Iron Co....
..... Cleveland.
Fore River Shipbuilding Co.....
..... Quincy, Mass.

FLUE WELDING.
Fix's S. Sons.....Cleveland.

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Hanna, M. A. & Co.....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Pickands, Mather & Co., Cleveland.
Pittsburg Coal Co.....Cleveland.
Smith, Stanley B., & Co., Detroit.

FURNACES FOR BOILERS.
Continental Iron Works, New York.

GAS BUOYS.
Safety Car Heating & Lighting Co..
..... New York.

GAS AND GASOLINE ENGINES.
Chase Machine Co.....Cleveland.

GAUGES, STEAM AND VACUUM.
Lunkenheimer Co. ..... Cincinnati.

GAUGES, WATER.
Lunkenheimer Co.....Cincinnati, O.

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General Electric Co.....
.....Schenectady, N. Y.

GRAPHITE.
Dixon Crucible Co., Joseph.....
.....Jersey City, N. J.

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Chase Machine Co.....Cleveland.

HOISTS FOR CARGO, ETC.
American Ship Building Co.....
..... Cleveland.
Brown Hoisting Machinery Co.....
..... Cleveland.
Chase Machine Co.....Cleveland.
Dake Engine Co.....
.....Grand Haven, Mich.
General Electric Co.....New York.
Hyde Windlass Co.....Bath, Me.
Marine Iron Co.....Bay City.

HOLLOW STAYBOLT IRON.
Falls Hollow Staybolt Co.....
.....Cuyahoga Falls, O.

HYDRAULIC DREDGES.
Great Lakes Engineering Works....
.... Detroit.

HYDRAULIC TOOLS.
Watson-Stillman Co., The.....
..... New York.

ICE MACHINERY.
Great Lakes Engineering Works....
..... Detroit.
Roelker, H. B.....New York.

INJECTORS.
American Injector Co.....Detroit.
Jenkins Bros.....New York.
Lunkenheimer Co. ..... Cincinnati.
Penberthy Injector Co.....
..... Detroit, Mich.

INSURANCE, MARINE.
Elphicke, C. W. & Co.....Chicago.
Gilchrist & Co., C. P.....Cleveland.
Hawgood & Co., W. A., Cleveland.
Helm & Co., D. T.....Duluth.
Hutchinson & Co.....Cleveland.
McCarthy, T. R.....Montreal.
McCurdy, Geo. L.....Chicago.
Mitchell & Co.....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Peck, Chas. E. & W. F.....
.....New York and Chicago.
Prindiville & Co.....Chicago.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago.

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Keep Your Boiler Clean

TRADE METLA-COTA MARK

Metla-Cota cleans the interior surface of boilers, plates and tubes. It takes off scale and prevents further formation by producing a thin non-corrosive coating on the metal, which does not interfere with the efficiency of the boiler. Metla-Cota does not cause foaming, saves labor, fuel and repairs. We don't expect this card to convince you of our claims. The trial order does that.

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Office and Factory, 36 Michigan St. CLEVELAND, OHIO.

DEARBORN DRUG & CHEMICAL WORKS

WM. H. EDGAR, Founder

DEARBORN FEED-WATER TREATMENT

Made to suit the water as per analysis, used regularly, keeps boilers free from scale and prevents any corrosive action the boiler water may have on the iron.

Economy of operation is possible only with clean boilers.

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299 Broadway, NEW YORK

Views of New Lake Vessels

Excellent photographs of the following vessels which came out during the season of 1905, may be had for $1.00, postage paid.

Negative size 8 x 10 inches

Ball Brothers	Hoover & Mason	Lyman C. Smith
Stephen M. Clement	George W. Perkins	John Stanton
Wm. E. Corey	Wm. A. Paine	Amasa Stone
James Davidson	Francis L. Robbins	Superior
Henry C. Frick	Geo. H. Russel	Sylvania
Elbert E. Gary	Wm. A. Rogers	James P. Walsh
Leonard C. Hanna	Powell Stackhouse	James C. Wallace
Frank J. Hecker	Socapa	Peter White

For Sale by

THE MARINE REVIEW

CLEVELAND

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Buyers' Directory of the Marine Trade---*Continued.*

IRON ORE AND PIG IRON.
Bourne-Fuller Co.....Cleveland, O.
Hanna, M. A. & Co.....Cleveland.
Pickands, Mather & Co., Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

LIFE PRESERVERS, LIFE BOATS, BUOYS.
Armstrong Cork Co.....Pittsburg.
Carley Life Float Co.....New York, N. Y.
Drein, Thos. & Son..... Wilmington, Del.
Kahnyweiler's Sons, D.....New York.

LIGHTS, SIDE AND SIGNAL.
Russell & Watson.....Buffalo.

LOGS.
Nicholson Ship Log Co., Cleveland.
Walker & Sons, Thomas..... Birmingham, Eng.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Joseph.....Jersey City, N. J.

LUBRICATORS.
Lunkenheimer Co. ..... Cincinnati.

LUMBER.
Martin-Barriss Co. ..... Cleveland.

MACHINISTS.
Chase Machine Co.....Cleveland.
Hickler Bros., Sault Ste. Marie, Mich.
Lockwood Mfg. Co.....East Boston, Mass.

MACHINE TOOLS (WOOD WORKING).
Atlantic Works, Inc....Philadelphia.

MARINE RAILWAYS.
Hickler Bros., Sault Ste. Marie, Mich.

MARINE RAILWAYS, BUILDERS OF.
Crandall & Son, H. I.....East Boston, Mass.

MATTRESSES, CUSHIONS, BEDDING.
Fogg, M. W.....New York

MECHANICAL DRAFT FOR BOILERS.
American Ship Building Co..... Cleveland.
Detroit Ship Building Co., Detroit.
Great Lakes Engineering Works.... Detroit.

METALLIC PACKING.
Katzenstein, L. & Co., New York.
The National Metallic Packing Co..
.....Oberlin, O.

MOTORS, GENERATORS—ELECTRIC.
General Electric Co:.....Schenectady, N. Y.

NAUTICAL INSTRUMENTS.
Ritchie, E. S., & Sons..... Brookline, Mass.

NAVAL ARCHITECTS.
Hynd, Alexander .....Cleveland
Kidd, Joseph .....Duluth, Minn.
Mosher, Chas. D.....New York.
Nacey, James .....Cleveland
Wood, W. J.....Chicago

OAKUM.
Stratford, Oakum Co.....Jersey City, N. J.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph.....Jersey City, N. J.

PACKING.
Jenkins Bros.....New York.
Katzenstein, L. & Co...New York.
Robertson, Jos. L. & Sons.....New York.
The National Metallic Packing Co... Oberlin, O.
Republic Belting & Supply Co.....Cleveland, O.

PAINTS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co.....Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc. ..Philadelphia.

PILE DRIVING AND SUBMARINE WORK.
Buffalo Dredging Co.....Buffalo.
Dunbar & Sullivan Dredging Co.... Buffalo.
Great Lakes Dredge & Dock Co.... Chicago.
Hickler Bros..Sault Ste. Marie, Mich.
Hubbell Co., H. W...Saginaw, Mich.
Parker Bros. Co., Ltd.....Detroit.
Smith Co., L. P. & J. A...Cleveland.
Starke Dredge & Dock Co., C. H... .....Milwaukee.
Sullivan, M.....Detroit.

PIPE, WROUGHT IRON.
Bourne-Fuller Co.....Cleveland, O.

PLANING MILL MACHINERY.
Atlantic Works, Inc....Philadelphia.

PLATES—SHIP, STRUCTURAL, ETC.
Bourne-Fuller Co.....Cleveland, O.
Otis Steel Co.....Cleveland.

PRESSURE REGULATORS.
Ross Valve Co.....Troy, N. Y.

PROPELLER WHEELS.
American Ship Building Co..... Cleveland.
Atlantic Works ..East Boston, Mass.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co....Detroit.
Fore River Shipbuilding Co..... Quincy, Mass.
Great Lakes Engineering Works.... Detroit.
Hyde Windlass Co.....Bath, Me.
Lockwood Mfg. Co.....East Boston, Mass.
Milwaukee Dry Dock Co.....Milwaukee.
Newport News Ship Building Co.. .....Newport News, Va.
Roelker, H. B.....New York.
Sheriffs Mfg. Co.....Milwaukee.
Superior Ship Building Co.....Superior, Wis.
Thropp & Sons Co., J. E..... .....Trenton, N. J.
Toledo Ship Building Co.....Toledo.
Trout, H. G.....Buffalo.

PROJECTORS, ELECTRIC.
General Electric Co.....Schenectady, N. Y.

PUMPS FOR VARIOUS PURPOSES.
Great Lakes Engineering Works.. ..... Detroit.
Kingsford Foundry & Machine Works .....Oswego, N. Y.
Wheeler Condenser & Engineering Co. .....New York.

RANGES.
Stamford Foundry Co..... .....Stamford, Conn.

REFRIGERATING APPARATUS.
Great Lakes Engineering Works.... ..... Detroit.
Roelker, H. B.....New York.

REGISTER FOR CLASSIFICATION OF VESSELS.
Great Lakes Register.....Cleveland.

RIVETS, STEEL FOR SHIPS AND BOILERS.
Bourne-Fuller Co.....Cleveland, O.

RUBBER SUPPLIES.
Republic Belting & Supply Co..... Cleveland, O

SAFETY VALVES.
Lunkenheimer Co.....Cincinnati.

SAIL MAKERS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co.....Cleveland.

SALVAGE COMPANIES.
See Wrecking Companies.

SEARCH LIGHTS.
General Electric Co.....Schenectady, N. Y.

SHEARS.
See Punches, and Shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne-Fuller Co.....Cleveland, O.
Otis Steel Co.....Cleveland.

SHIP BUILDERS.
American Ship Building Co..... Cleveland.
Atlantic Works ..East Boston, Mass.
Buffalo Dry Dock Co.....Buffalo.
Cramp, Wm. & Sons..Philadelphia.
Chicago Ship Building Co..Chicago.
Detroit Ship Building Co....Detroit.
Fore River Ship Building Co..... ..Quincy, Mass.
Great Lakes Engineering Works.....Detroit.
Lockwood Mfg. Co.....East Boston, Mass.
Manitowoc Dry Dock Co.....Manitowoc, Wis.
Maryland Steel Co.....Sparrow's Point, Md.
Milwaukee Dry Dock Co..... Milwaukee.
Newport News Ship Building Co... .....Newport News, Va.
New York Shipbuilding Co..... .....Camden, N. J.
Roach's Ship Yard.....Chester, Pa.
Shipowner's Dry Dock Co..Chicago.
Toledo Ship Building Co.....Toledo.

SHIP CHANDLERS.
Baker, Howard H. & Co....Buffalo.
Marine Mfg. & Supply Co..... New York.
Upson-Walton Co.....Cleveland.

SHIP DESIGNERS.
Kidd, Joseph .....Duluth.
Steel, Nacey, & Hynd....Cleveland.
Wood, W. J.....Chicago.

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ON
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A REVOLVING CLAMSHELL DREDGE

which will do the following impossibilities to the ordinary dredge:

Excavate 60′ back from face of dock into scow or vice versa. Excavate at either end of itself and dump in scow at other end. This makes through cutting and cleaning narrow slips cheaply possible. Excavate trenches to 150′ or more depth. Excavate material and throw it one side 150′ from original site where there is four feet of water between dump and channel. Excavate shallow channels down to 4′ x 44′. Clean out boulders or obstructions without disturbing surrounding bottom Excavate close to docks without injury to dock. Anything that ordinary derrick will do up to 10 tons at 75′ radius.

This is an excellent wrecking tool.

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Capacity, 1,000 tons. Draft, 7½ ft. forward, 13½ ft. aft. Length on keel blocks, 180 ft.; over all, 190 ft.

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Upson-Walton Co..... Cleveland.

SHIP TIMBER.
Martin-Barriss Co.....Cleveland.

SIGNALS—SUBMARINE.
Submarine Signal Co.....Boston

SMOOTH-ON COMPOUND, FOR REPAIRS.
Smooth-On Mfg. Co.....
.....Jersey City, N. J.

STAYBOLT IRON OR STEEL BARS, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.....
.....Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.
Holmes, Samuel .....New York.
McCarthy, T. R.....Montreal, Can.

STEAMSHIP LINES, PASS, AND FREIGHT.
American Line .....New York.
Anchor Line .....Buffalo.
Boston Steamship .....Boston.
C. & B. Transit Co.....Cleveland.
International Mercantile Marine Co.
.... Philadelphia.
Mallory Line .....New York.
New York & Cuba Mail S. S. Co..
....New York.
Red Star Line .....New York.

STEAM SPECIALTIES.
Robertson, Jas. L. & Sons ..New York.

STEEL CASTINGS.
Otis Steel Co.....Cleveland.

STEERING APPARATUS.
American Ship Building Co.....
....Cleveland.
Chase Machine Co.....Cleveland.
Dake Engine Co.....
.....Grand Haven, Mich.
Detroit Ship Building Co....Detroit.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....
....New York.
Sheriffs Mfg. Co.....Wilwaukee.

SUBMARINE DIVING APPARATUS.
Morse & Son, A. J.....Boston.
Schrader's Son, Inc. A....New York.

SURVEYORS, MARINE.
Hynd, Alexander .....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Nacey, James .....Cleveland.
Steel, Adam .....Cleveland.
Wood, W. J.....Chicago.

TESTS OF MATERIALS.
Hunt, Robert W. & Co....Chicago.
Lunkenheimer Co....Cincinnati, O.

THERMIT.
Goldschmidt Thermit Co., ...
..... New York City.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.
Watson-Stillman Co.....New York.

TOOLS, WOOD WORKING.
Atlantic Works, Inc....Philadelphia.

TOWING MACHINES.
American Ship Windlass Co.....
.....Providence, R. I.
Chase Machine Co.....Cleveland

TOWING COMPANIES.
Donnelly Salvage & Wrecking Co..
.....Kingston, Ont.
Great Lakes Towing Co..Cleveland.

TRUCKS.
Boston & Lockport Block Co.....
..... Boston.

TUBING, SEAMLESS.
Shelby Steel Tube Co..Pittsburg, Pa.

VALVES, STEAM SPECIALTIES, ETC.
Jenkins Bros. .....New York
Lunkenheimer Co.....Cincinnati.
Ross Valve Co.....Troy, N. Y.

VALVES FOR WATER AND GAS.
Ashton Valve Co.,.....Boston.
Lunkenheimer Co.....Cincinnati.
Republic Belting & Supply Co.....
....Cleveland, O.
Ross Valve Co.....Troy, N. Y.

VESSEL AND FREIGHT AGENTS.
Boland, John J.....Buffalo.
Elphicke, C. W. & Co.....Chicago.
Hall, John B.....Buffalo.
Helm & Co., D. T.....Duluth.
Hawgood & Co., W. A....Cleveland.
Holmes, Samuel .....New York.
Hutchinson & Co.....Cleveland.
McCarthy, T. R.....Montreal.

VESSELS AND FREIGHT AGENTS—Con.
Mitchell & Co.....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Prindiville & Co.....Chicago.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago

WATER GAUGES.
Lunkenheimer Co.....Cincinnati, O.

WHISTLES, STEAM.
Lunkenheimer Co.....Cincinnati.

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Bunker, E. A..... New York.

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Baker, H. H. & Co.....Buffalo.
Upson-Walton Co.....Cleveland.

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American Ship Windlass Co.....
..... Providence, R. I.
American Ship Building Co.....
..... .Cleveland.
Dake Engine Co.....
.....Grand Haven, Mich.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....
....New York.

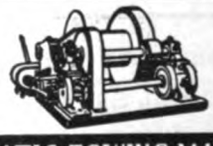
WINCHES.
American Ship Windlass Co.....
.....Providence, R. I.
Hyde Windlass Co.....Bath, Me.

WOOD WORKING MACHINERY.
Atlantic Works, Inc....Philadelphia.

WRECKING AND SALVAGE COMPANIES.
Donnelly Salvage & Wrecking Co..
..... Kingston, Ont.
Great Lakes Towing Co..Cleveland.
Parker Bros. Co., Ltd.....Detroit.

YACHT AND BOAT BUILDERS.
Drein, Thos. & Son.....
..... Wilmington, Del.
Manitowoc Dry Dock Co.....
..... Manitowoc, Wis.
Truscott Boat Mfg. Co.....
.....St. Joseph, Mich.

YAWLS.
Drein, Thos. & Son.....
..... .Wilmington, Del.



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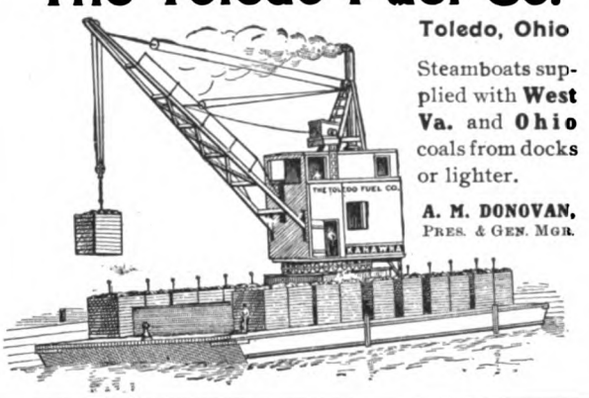

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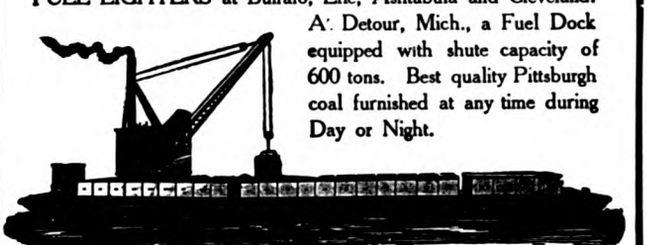

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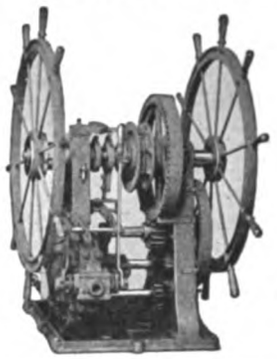

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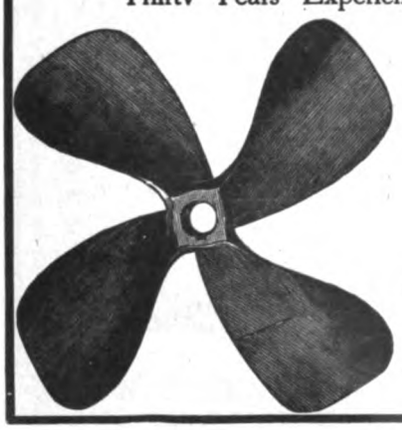

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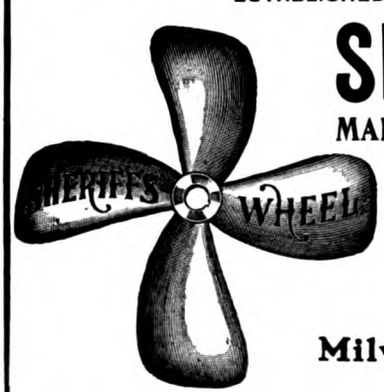

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Finland (12,760 tons)	**Kronland** (12,760 tons)
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900 Locust St., St. Louis.
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Both together being, without doubt, in all respects the finest and fastest that are run in the interest of the traveling public in the United States.

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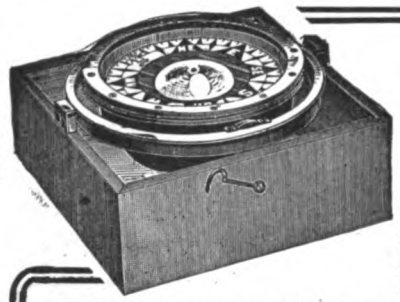

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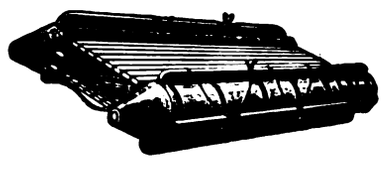

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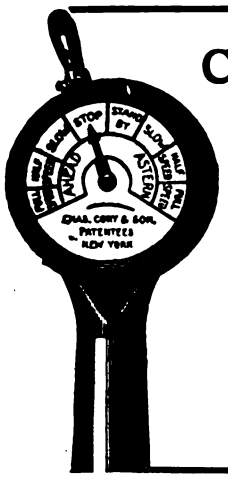

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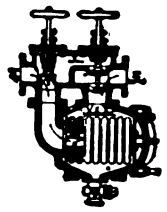

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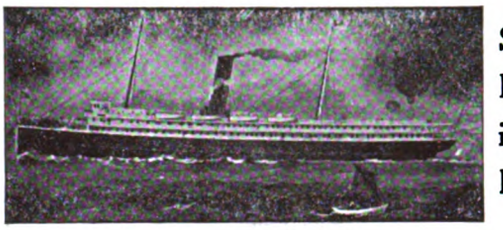

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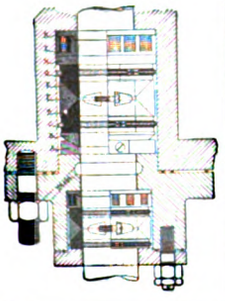

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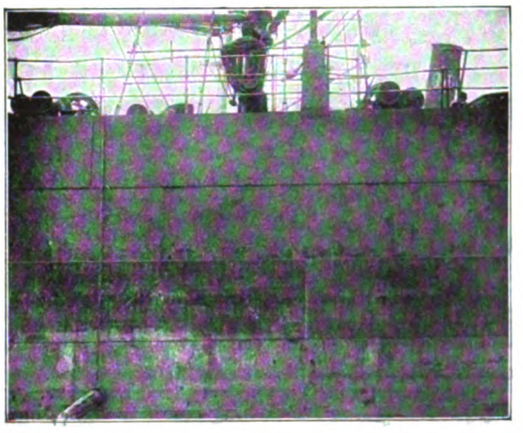

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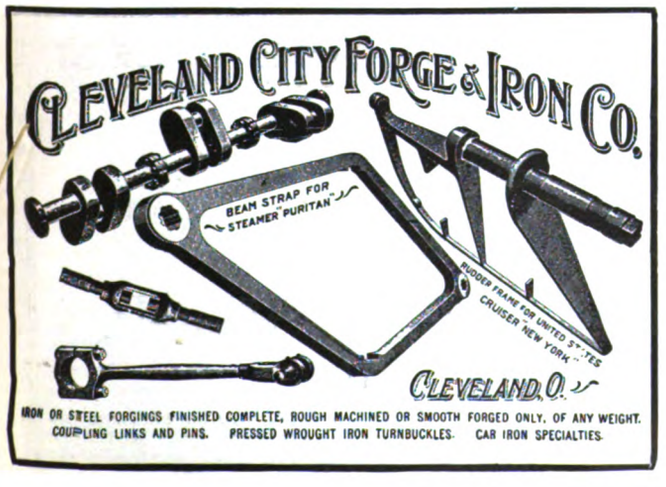
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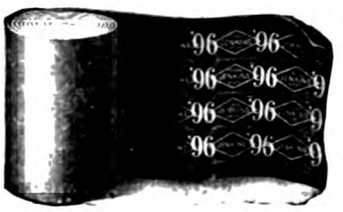

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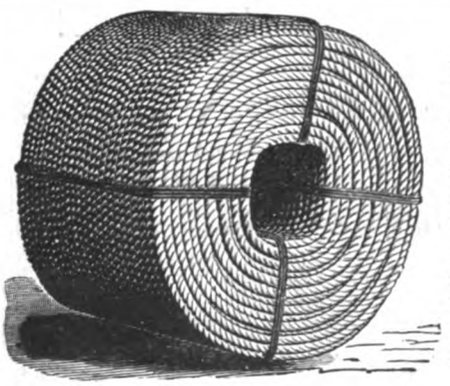

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